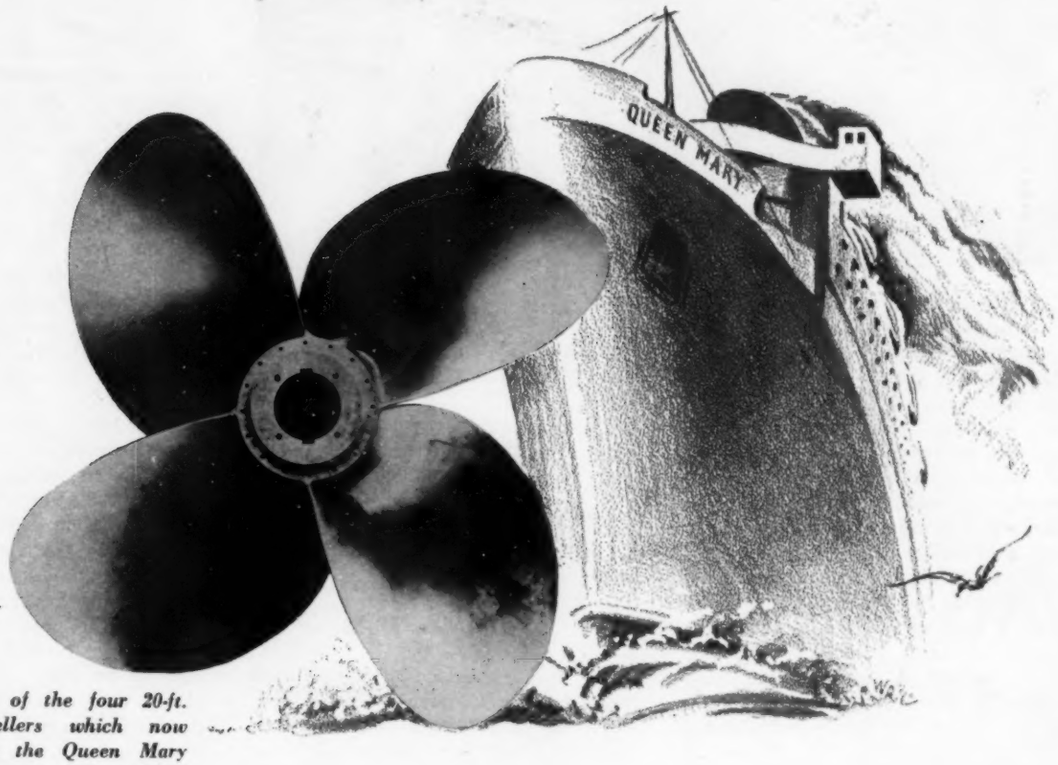
American Machinist

NOVEMBER 18, 1936



Each of the four 20-ft. propellers which now drive the Queen Mary across the seas weighed 53 tons as cast, 35 tons when finished

BRONZE WINGS for the SEA QUEEN

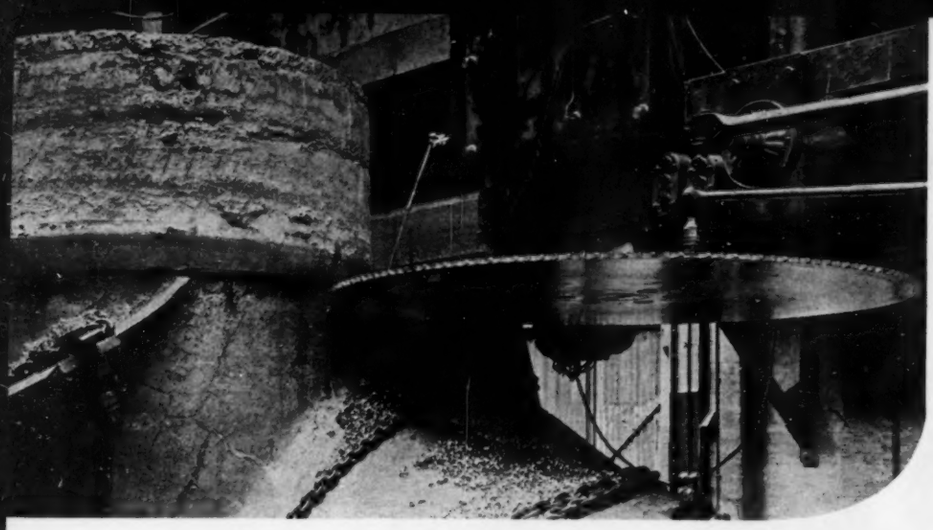
A. EYLES
Mechanical Engineer
St. Albans, England

Back of the *Queen Mary's* record-breaking Atlantic crossing lies the craftmanship of the men who fashioned the tons of red metal that propelled her to her triumph

LATE on a summer's night last August, the *Queen Mary* plunged past the Ambrose Lightship to win the mythical blue pennant for the fastest Atlantic passage by an ocean liner. The new record of 4 days, 7 hours, 12 minutes from Cherbourg represented an average speed of 30.01 knots.

Credit goes to a gallant crew for this triumph, but behind their achievement are the efforts of other crews who labored in British metal-working shops and shipyards to supply the mechanical essentials that make such sea sagas possible. One such crew is employed in the plant of J. Stone & Company, Ltd., at Deptford, London, England. Their part in the record-breaking trip was in fabricating the huge bronze propellers that whirled beneath the sea to speed the *Queen Mary* to her goal.

No novice in propeller making, this plant also supplied similar equipment for the *Normandie*, the *Queen Mary's* dethroned rival. In 1889, J. Stone &



A 6-ft. saw mounted in a boring machine head takes off the bronze riser in four bites

Company developed Turbiston bronze (an alloy of copper 55, zinc 41, nickel 2, manganese 0.16, iron 0.84, aluminum 1), which proved to be an important step in its history. Since then it has supplied propellers of this material for all classes of vessels, naval and merchant, including the Mauretania, Majestic, Bremen, Europa, Berengaria, and Aquitania.

Propeller construction, particularly in respect to the blade, varies considerably; a little extra speed or a greater degree of stability may be imparted by some slight modification. The works of J. Stone & Company, which is the largest in the world devoted exclusively to this product, is now in the course of constructing propellers with three, four and five blades, with blades perpendicular to the shaft or raked forward or aft, with constant or varying pitch, and of solid or built-up types. Naturally such wide deviation from any standard precludes the use of permanent patterns, molds or gages.

In making the propeller casting, no pattern in the accepted sense, is employed; each mold is built up step by step with the process repeated for each propeller. Several weeks are involved in completing a propeller of large diameter.

A 100-Ton Mold

The mold is erected on a dead level metal foundation some 24 ft. in diameter. In the center of the base, slightly raised from the surface is an iron building plate several inches thick, the diameter of which depends on that of the mold under construction.

For the bronze propellers for the *Queen Mary*, no less than 1,500 bricks, 20 tons of sand and 30 tons of iron and steel were used before a mold was completed. The total weight of a mold was over 100 tons.

Two ladles were used in casting each of the propellers because of the abnormally large quantity of bronze required. The molten metal enters the mold from the bottom so any scum or dross is carried up to the core mouth and is easily removed. When the metal is cold, the pit is opened and the brickwork structure is broken down prior to removal of the casting. Although the actual pouring of the *Queen Mary's* propellers took only about seventeen minutes, it was necessary for the casting to be kept in the pit about ten days to permit cooling.

A propeller casting, coming from the foundry is first mounted on a lining-up table on the surface of which a series of concentric grooves are scored. The boss of the propeller is centered on the table, resting on three jack screws. By adjusting these, the blades are set up true to pitch by checking with templets located in the grooves.

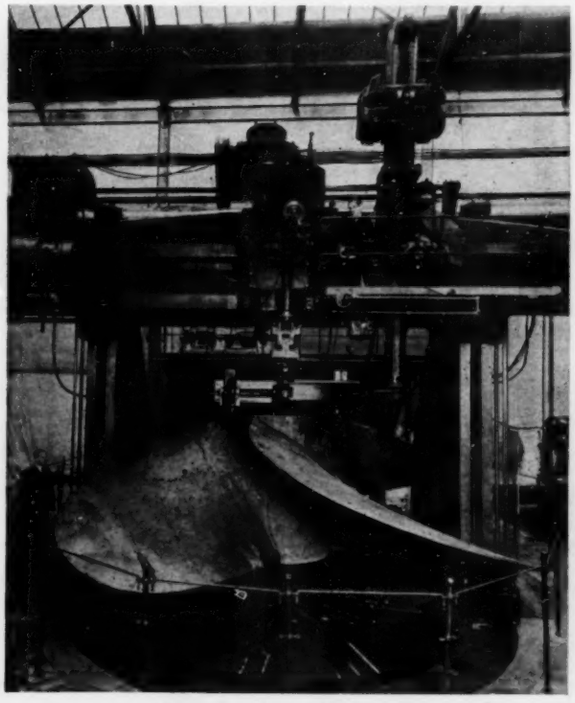
With the casting correctly set up, a line is scribed around the boss to facilitate mounting the propeller correctly for boring and facing the boss. In boring and removing the riser,

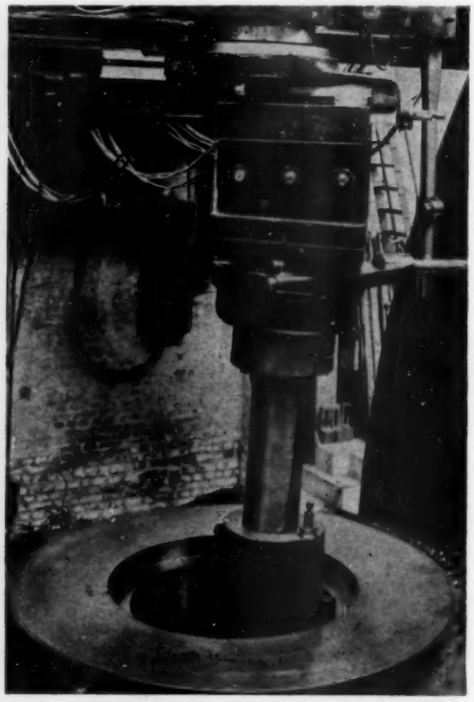
The hub of the huge casting is faced, fore and aft, in a 160-ton boring mill

Only after it is correctly lined up from the pitch of the blades can the bronze casting be bored

Keyseating is done in the same machine that performed the sawing, boring and facing operations

The aft blade faces are planned in a special machine designed to follow their contour





a large amount of bronze is machined away, which in the case of a ten-ton propeller would approximate two tons. The peripheral speed of the 6-ft. diameter inserted-tooth saw used for cutting off the riser is 111.5 ft. per min. The feed is obtained by traversing the head supporting the saw along the crossrail and may be varied from 1¾ to 6 in. per min. A large riser is removed in four cuts, the table being indexed 90 deg. after each cut. The smaller risers can be removed in two cuts by indexing 180 deg. after the first. The keyway is cut in the same set-up using the vertical motion of the boring mill ram with a special tool holder having adjustment traversely and feed in the direction of cut.

After boring and facing operations have been completed, whether on a lathe or on boring mill, propellers are taken to specially designed planing machines for machining the aft blade faces true to pitch. The cuts may be likened to a spiral staircase, the treads representing the path of the tool from edge to center. The drive for this operation is obtained from a motor and gear reduction unit which transmits power to a vertical shaft. This in turn operates a vertical slide through a worm and worm-sheel unit. A crank arm connected to this slide is linked to the ram carrying the tool holder to impart a rocking motion as the worm-wheel rotates. The movement resembles that used in driving the ram of a shaper, with the usual quick return and means for adjustment of stroke.

Drilling operations may be few or many according to the design of the propeller. The aft face of the bore usually requires a number of holes for the attachment of the cone cap and for the purpose of withdrawing the propeller from its shaft. The forward end may require drilling to accommodate parts of the gland unit.

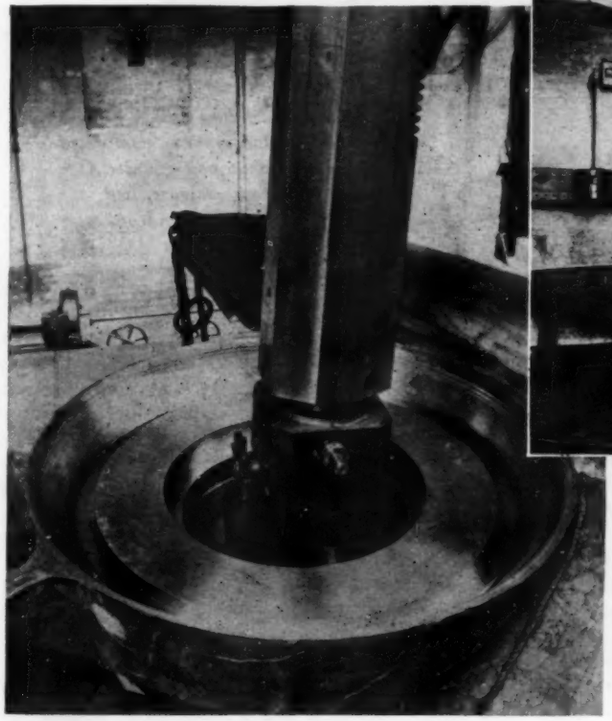
New Machine Development

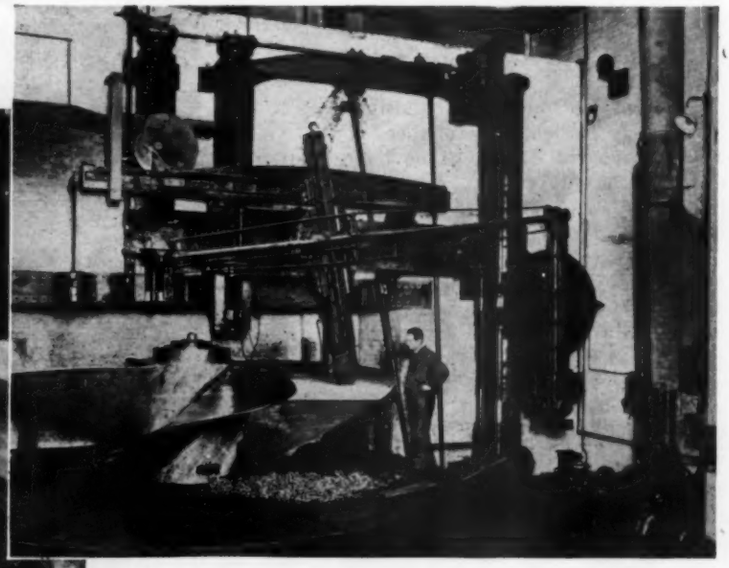
Propeller blades are machined only on one side. The reason for this is that the surface of the back varies greatly with the width, length and thickness of the blades and the type of blade section employed. At present, the machine adaptable to such varying contours would involve an elaborate system of controlling mechanism. Variations in propeller design are so great that tool equipment for such a set-up might be used only once. However, machines are now being developed by means of which both sides of the blade may be finished. To what extent such equipment will be employed will depend largely on the degree of simplicity and adaptability of the controlling mechanism. Present practice is to finish the backs of propeller blades by hand operation carried out in the fettling shop. Prior to the start of this work, the propeller undergoes the process known as "lining out" to ascertain the amount of excess metal.

For this purpose, specially designed equipment is employed comprising a work table and a central column which pilots a long graduated scale. The propeller is mounted on the work table with the machined surfaces of the blade uppermost; these surfaces are covered with a marking paste. Excess metal is chipped from the rough sides of the blade with pneumatic chisels and the edges are thinned down to gage size. The propeller is then balanced, and when any necessary adjustments have been made, smoothed off by use of hand grinders fitted with abrasive disks. Final finish is usually obtained by polishing with emery.

For purposes of comparison, the castings and finished weights of propellers fitted to large ocean liners are given. All of these were made of Turbiston bronze.

According to *Industrial Britain*, the keel of No. 552, a sister ship of the *Queen Mary*, will be laid soon at the Clyde Bank yard of John Brown & Company. Studies of the performance of the *Queen Mary* during her trip across the Atlantic have indicated that the new vessel will not depart greatly from the design of her sister. A possible exception is the arrangement of engine rooms where alterations may be made.





SHIP	CASTING WEIGHT	FINISHED WEIGHT	PROPELLER DIAMETER
Queen Mary	53 tons	35 tons	20 ft. 0 in.
Normandie	37 tons	23¼ tons	16 ft. 0 in.
Mauretania	29 tons	18¼ tons	16 ft. 9 in.
Majestic	30 tons	15¼ tons	16 ft. 6 in.
Bremen	35 tons	18¾ tons	16 ft. 5 in.
Europa	27 tons	14 tons	15 ft. 0 in.

RAILROAD FREAKS I Have Seen

FRED H. COLVIN
Editor

XIV—Crack-pot ideas are the bane of every editor's life, but the Patent Gazette has recorded tens of thousands of impractical and unbelievably silly railroad inventions. A few of these ideas and the personalities back of them are recalled by Mr. Colvin, who has seen his share of "mechanical hopes"

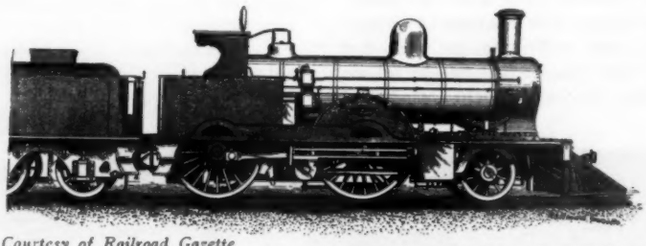
INTENSE and general interest in early railroading blew off the lid of inventive genius and out poured some of the most notable freaks ever perpetrated in mechanical history. Surprisingly enough, some of them attracted sufficient capital to be built, and countless inventors spent their pitiful all to make working models that got no farther than that stage.

Patent office records show that most never got beyond the dream stage. One in particular, I remember, was a locomotive and train equipped with a complete trackage unit on top of it. This was to serve the double purpose of preventing collisions and of saving time on single track roads. The meeting trains simply went up on the elevated track on the train, down at the rear end, and went on its way—perhaps! Which train was to take the high road and which the low, if both were equipped with this trackage, was not a part of the patent. Then too, a streamlined train was patented about 70 years ago, and illustrated by the *Railway Age* within a few years.

One epidemic of freaks began in the latter part of the nineteenth century —when I was a boy in Philadelphia. The outstanding competitor for the title was the Fontaine locomotive which I saw while it was being tried on the Pennsylvania railroad. It would be interesting to know what brand of nightmare was responsible for this monstrosity. Unbelieveable as it seems, the locomotive was driven by a pair of driving wheels mounted above and resting on another pair of wheels that ran on the track. The boiler was hung so that these second story drivers carried the weight and gave them traction on the idling drivers which ran on the rails. The cylinders were at a sharp angle in order to drive the upper set of wheels.

The arrangement, as well as the absurdity of the whole idea, can be seen in the accompanying cartoon which illustrated a caustic comment on the design by that eminent authority, M. N. Forney, then editor of the *Railroad Gazette*. The illustration and comment were reproduced in the *American Machinist* of December 24, 1881. This was two years before I went into the shop. But the cartoon made such an impression on me that I had little difficulty in locating it in our library. This also indicates an interest in things mechanical before my direct connection with the industry. It seems hardly possible that such a locomotive could have been built and run, but such is the case. Whether it shows an utter lack of mechanical understanding, or a progressiveness that was willing to try anything once, I leave to the reader.

Counterbalancing of the reciprocating parts of locomotives has long been a subject of strenuous discussion. Hammer-blow and its effect on rails and roadbed, was the bugaboo of the motive power and maintenance of way department. A wealthy man by the name of Lockwood, whose money, as I recall, came from the making of paper collars of sacred memory, made the welkin ring with the dire effects of unbalance, both as to cost and as the cause of accidents. His crusade was not entirely philanthropic, however, as he had been induced by a dreamer by the name of Shaw to finance a balanced locomotive.



Courtesy of Railroad Gazette

Nicknamed "John Bull," Webb's compound locomotive comprised two independent power units. One drove the rear drivers and the other connected to the front pair

Shaw obtained balance by using two cylinders on each side of the locomotive, these driving a double crank set at 180 degrees. The crank pins on the other side were of course set at 90 degrees to the first side but at the same 180 degrees to each other. The design and construction of these double cranks in each driving wheel was a source of constant trouble. They resembled the crankshaft of a hay tedder more than part of a locomotive. The stresses imposed on the wheel fit of the crankpins, by the outer connecting rods, can easily be imagined. And so, in spite of Shaw and Lockwood's vociferous claims for superiority, it was a short lived wonder. A

slow motion movie of the corkscrew-like crank in action would be a revelation.

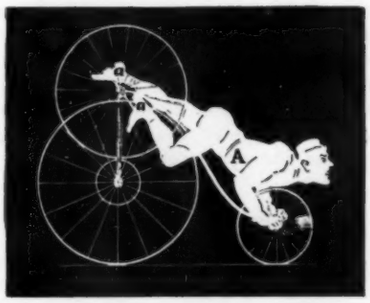
Valve motions were receiving a lot of attention about this time and they afforded me some excellent exercises in mechanical drawing, which I was taking up on the side, with father's valuable assistance. The old Stephenson link motion was being attacked by advocates of the Walschaert and the Joy. The former was German as I remember, and the latter English. The little locomotives of the Boston and Revere Beach narrow gage road, built perhaps 70 years ago, had Walschaert valve gear for the very good reason that there was not room underneath for the regular link motions. The Joy motion was of the radial type, also on the outside, and great economies were claimed for it. Then came George Strong with his modification of the Joy—and with a locomotive for demonstrating its advantages. Later came the Baker and Pilliod valve gears. But a study of present day locomotives will show the almost complete adoption of the more or less modified Walschaert gear—largely because the growth in size of the locomotive makes the outside type of gear more convenient in every way.

Another Freak

Next to the Fontaine idea, the Swinnerton driving wheel probably takes second place in the list of top-flight freaks. And, unless I am mistaken, Swinnerton was a railroad man who should have known better. In order to increase traction, and prevent slippage, he had flat facets about one and one-eighth inches wide, or long, milled around the periphery of the driving wheels. The sharp corners were to grip the rails and insure constant traction. These were tried on the Jersey Central, I think, and later on one of the small locomotives of the New York Elevated road. What an opportunity this would have made for enforcers of Mayor La Guardia's anti-noise crusade! Just imagine the racket of a pair of driving wheels with nothing but flats on the periphery! Needless to say the idea died suddenly.

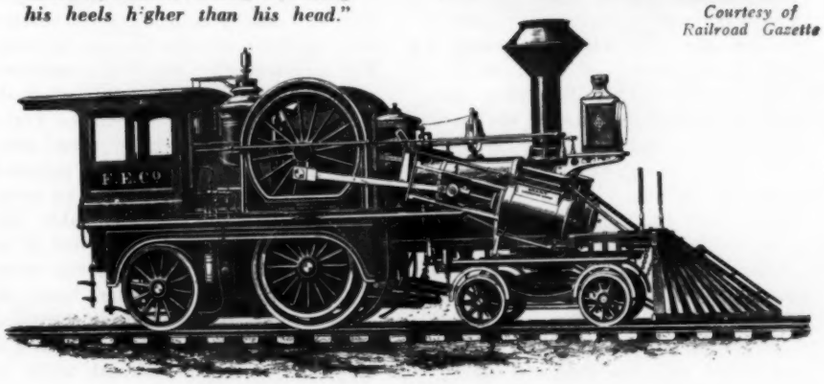
Harking back to the Fontaine and its inclined cylinders recalls a conversation with an old time master mechanic. He too was reminiscing, and told me of the wonderful pulling power of the old Mason locomotives, built in Taunton, Mass. Their superiority over others, which he claimed existed, was attributed to the fact that Mason set his cylinders at an angle, the front end perhaps ten degrees higher than the rear. In this way, he explained, the driving wheels secured a better grip on the rails and made them superior. Just what happened on the return stroke did not enter into his calculations.

Compound locomotive activities were stirred in this country by the Webb compound, in England. Lockwood, of Shaw locomotive and paper collar fame, was a thorn in the flesh at stockholders' meetings of the Pennsy. He persistently demanded to know why they were not taking advantage of the fuel economy made possible by the compound, until a Webb locomotive was imported to be promptly dubbed the "John Bull" by the men. It was a comparatively light locomotive with two high pressure cylinders on the outside, driving the rear pair of drivers, and a large, low pressure cylinder in the center, coupled to the crank axle of the front pair. Strangely enough there were no side rods so that there were virtually two independent units. As can be imagined, the starting of the two units simultaneously, with a load, was no job for an amateur.



Courtesy of Railroad Gazette

Fifty-five years ago American Machinist reproduced a terse comment made on the Fontaine locomotive with this cartoon. It was captioned: "The method of operating a pair of cranks, aa, by means of another 'crank,' A, having his heels higher than his head."



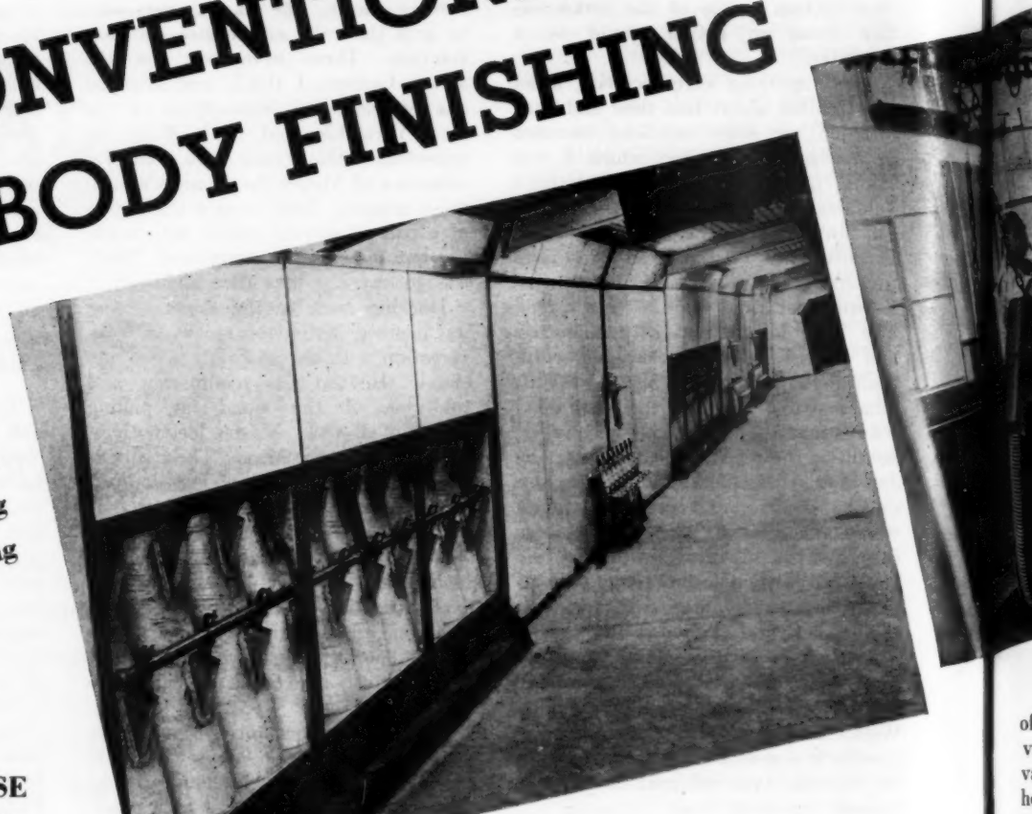
Rode Hard, But Saved Money

The John Bull was a hard rider and the cab did not give the engine crew nearly the protection of our own locomotives. These features, coupled with reluctance to tackle a new job and perhaps a bit of over-developed nationalism, made it hard to find a man who could, or would, give it a fair trial. Finally one of the good engineers, Wesley Hartman, whom I knew, tackled the job, partly because of the experience and also in the belief that he could earn a substantial bonus on fuel allowance which was then in force. Wes Hartman ran the John Bull on the fast New York-Philadelphia runs for months and both he and the fireman drew down a fat bonus on fuel saving. After he got it under way the Webb would roll very smoothly. But Wes lost a lot of weight during those months on the John Bull.

In the meantime the locomotive builders in this country were designing and building compound locomotives. Vauclain, of Baldwin, Pitkin of Schenectady, and others including Brooks, Pittsburgh, Rhode Island and Richmond built compounds of various types. The Pittsburgh compound was made under patents issued to my father, by our mutual friend D. A. Wightman. This was before the merger of the eight small locomotive plants into the American Locomotive Co. The Pennsylvania railroad also designed its own compound.

None of these compounds has survived the stress of time although there are still railway men who feel that complete abandonment was a mistake. As in numerous other cases we may have rushed in too hastily and abandoned the compound before we learned to select the best type. Some of the designs were certainly very crude and unmechanical from a maintenance standpoint. Practically all of them could show fuel economy when used in the right service. But the cost of maintenance, and its effect on keeping traffic moving, was probably largely responsible for the abandonment of the compound locomotive.

UNCONVENTIONAL BODY FINISHING



Assembly of the Lincoln-Zephyr starts with the unit body-chassis, and finishing is done before the running gear is attached

HERBERT CHASE
Consulting Engineer

INTRODUCTION of the Lincoln-Zephyr necessitated a brand new layout for finishing the body (which is also the chassis of this car) and the sheet-metal parts which go into the assembled vehicle. All operations in finishing, trimming and assembling the body and car proper, and most of those on other sheet-metal work are performed while these elements move on overhead chain conveyors. There are nearly three miles of such conveyors in the Lincoln plant.

Unlike the practice in most finishing shops, sheet-metal work, after preliminary cleaning and chemical treatment, parallels the body lines on a separate conveyor and receives the same finishing operations which are given the body proper. Sheet-metal parts do not pass through the body spray booths but through supplementary booths which parallel them. These parts are removed from the conveyors and placed on jacks for sanding and polishing. They are then returned to the conveyor and continue beside the body line until used.

Lincoln spray booths represent a definite advance in their provision for ventilation and for recovery of waste lacquer spray. Air, which is first carefully cleaned and heated, is introduced through small holes which perforate the entire ceiling of the booths. This air passes downward around the bodies and (in the parallel booths) around sheet-metal parts and is exhausted at floor level; it carries with it spray dust and lacquer fumes, and takes these away from the breathing level of the operators.

Pigment Is Reclaimed

Having left the booths proper, the exhausted air and fumes are drawn upward through baffled tubes in which they encounter a spray of water in the opposite direction. The water is trapped and drawn off at about floor level, carrying with it the spray dust. Instead of flowing to waste, the water is carried to a settling tank where the solid matter is separated out, is dried, reground and used again in primer and surfacer coats. All of this effects considerable saving and prevents the discharge of spray dust into the atmosphere, as is common on the roofs of many plants.

All finishes used in the spray booths are mixed with the required solvents in a separate room, and the eight colors used are automatically pumped to the proper outlets in the booths. As colors are mixed by experts, there is no problem in matching or securing the desired color on parts later brought together in a given assembly. Also, there is no delay or waste of labor at the spray booths.

Among the other noteworthy features of equipment employed is an unusual system of mercury-vapor lighting. The familiar long-tube type of lamp is used along most lines outside the booths, while new 400-watt high-intensity units on 8 by 9-ft. centers are employed for spray-booth lighting. The high-intensity lamps are mounted above a ground-glass diffuser set flush in the 9-ft. spray booth ceilings. Light is dispersed to avoid shadows and minimize reflections on wet and polished surfaces. No specific data as to economy in painting are available for this particular installation, but it is understood that savings on the order of ten per cent in lacquer, time, repairs and rejects have been recorded where similar excellence in lighting is substituted for less efficient units.

Lacquer-laden air is drawn off at the bottom of the spray booth and passes upward through the water scrubbers at left, the solids being recovered in a settling tank for re-use

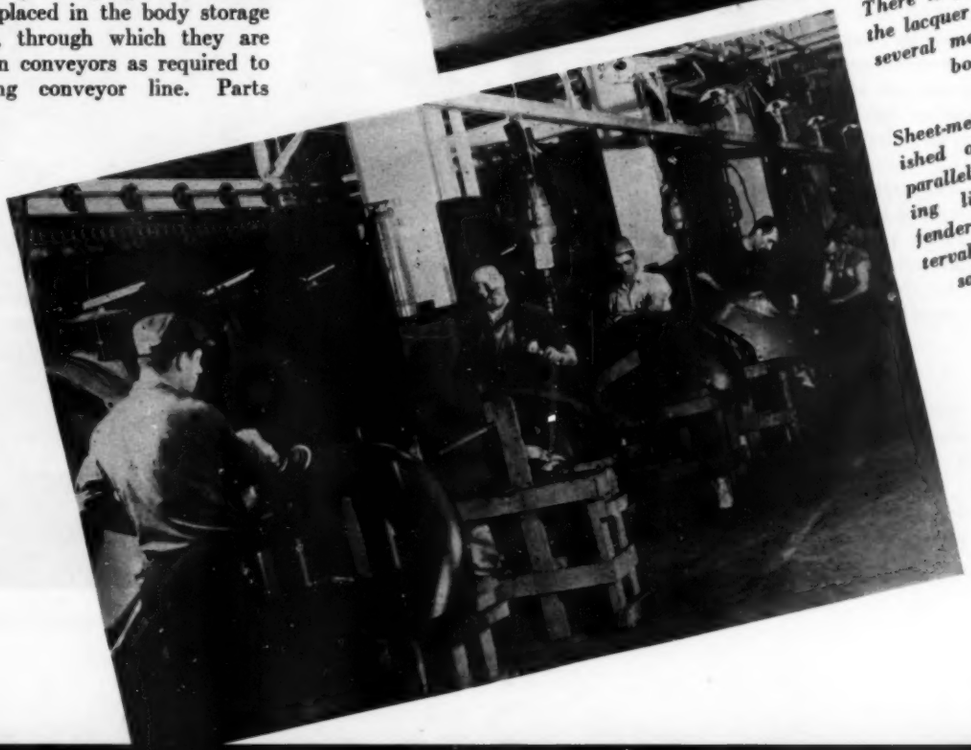
Long-tube mercury-vapor lighting illuminates the body without glare or reflections during wet rubbing

In the spray booths, as in all parts of the plant, unusual cleanliness prevails. Walls of spray booths are galvanized. They are washed down with hot water every night, and sprayed with soap solution which keeps the paint spray from sticking fast when the booth is again used. Twelve men work in each of the four spray booths for bodies, the latter passing through at the rate of about 3 ft. per min.

All finishing materials used are of the lacquer type, which dry with a minimum of baking and drying time. No high-temperature baking is required.

Bodies, assembled and ready for cleaning, are received from the Briggs Manufacturing Company's Le Baron plant, and placed in the body storage department, through which they are advanced on conveyors as required to the finishing conveyor line. Parts

There is plenty of room in the lacquer spray booths for several men to work on a body at once



Sheet-metal parts are finished on a conveyor line paralleling the body-finishing line; such parts as fenders are lifted off at intervals for operations like sanding and polishing

such as shock absorbers, muffler and wiring, normally associated with the chassis in a conventional car, are assembled to the body before preparation for finishing starts.

Cleaning includes what is called an ammonia wash, a hot-water rinse, hot caustic-soda wash and rinsing, after which the bodies are oven dried at 260 F. and then wiped with an alcohol solution.

At the same time, but in another department, the sheet-metal parts, which include fenders and wheels, are put through six alkali and other chemical and cleaning operations involved in the Spra-Bonderite system. This, of course, removes all grease and gives the metal a rust-resistant coating. During and following this treatment, the sheet-metal parts advance along their own chain conveyor line and issue into the finishing department where they receive the same treatment as the bodies while they progress along parallel lines.

Finishing Starts

Initial finishing operations include spot glazing, an air dry, sanding of the glaze and the spraying on of three coats comprising the primer and surfacer which are applied both to the inside and outside of the body and to all surfaces of the sheet-metal parts. These operations are followed by drying in an oven at 260 F. after which all exterior surfaces are water sanded. As many as eight men work on the body simultaneously during sanding and as the body proceeds continuously on the chain conveyor. To make sure that all moisture is removed, the body is next put through another oven at 260 F. It is then given another coat of surfacer, is spot puttied and spot sanded. This is followed by washing with water under pressure to remove all dust, the blowing out of all recesses with air and another baking at 260 F. to assure complete drying of all moisture.

Bodies as well as sheet-metal parts follow the foregoing and the following operations, the sheet-metal parts being removed from and returned to the conveyor provided for them as required. After the last-mentioned drying, bodies and parts are cleaned with tack rags and are then ready for receiving four successive color coats of lacquer. From the spray booths, bodies and parts are fed into the drying oven and subjected to a temperature of 160 F. until dry enough for the light sanding and polishing operations which follow. These operations are done in the usual way with motor-driven polishing wheels on flexible shafts. The mercury-vapor light from the long-tube lamps hung parallel to the conveyor lines gives excellent seeing conditions, free from glare and shadows.

Bodies Enter Trim Line

After the first polishing, spot spraying and touching-up are undertaken followed by the final oven drying at 160 F. This, in turn, is followed by spot polishing and by such minor brush touch-up work as is needed before inspection. Bodies thus finished continue along the trim line.

At the end of trim lines in plants making cars of conventional construction, the body with fenders attached is ready for mounting on the chassis which, in turn, has been assembled on another line. As there is no separate chassis in the Lincoln-Zephyr, however, it is necessary to assemble to the body frame most of the units such as go to make up a chassis in other cars. This work is done as the car proceeds continuously along what amounts to an extension of the same conveyor which carried the body along the trim line. Axles and other running gear are put in place, the power plant is set in position and other parts are assembled. Near the end of this line, wheels are attached, and the car then moves forward on its own wheels.

Final Touch-Up

When the car reaches the end of the assembly line, it may show some minor blemishes on the lacquered surfaces made inadvertently during the assembly operations. In consequence, there is provision for a final touch-up near the end of the assembly line. Here the car passes through a short touch-up spray booth. Should the spots requiring such touch-up involve refinishing any considerable area, this is dried by passing under banks of heater lamps carried on special adjustable fixtures.

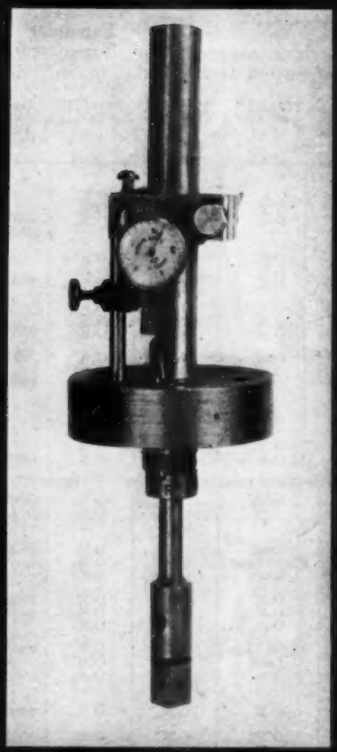
Great care is exercised, however, to see that bodies come up to the high standard of finishing which has always been a feature of Lincoln cars. Final inspection is done under the same type of mercury-vapor light used along the conveyor lines, as this type of lighting is especially effective in showing up blemishes which may escape notice even in daylight. In all operations, the placing and intensity of lighting is such as to give ample light inside as well as outside the bodies, so that there is little or no need for using droplights on extension cords.

Conveyor timing is such that, under normal production, 100 complete Lincoln-Zephyrs can be turned out in 8-hr. shift. During this period, a body normally makes a complete circuit of the finishing department.

After the motor and running gear are attached to the unit body-chassis, damaged spots in the finish are painstakingly touched up prior to final inspection under mercury light

TIGHT JOINTS for Condenser Tubes

GUY V. POLLARD
General Works Manager, Kelvinator Corporation



Elongation of the tube during the rolling-in process is measured by a test set-up with the expander, tube sheet and tube with dial indicator placed as shown

Extensive tests served to select the clearance, type of expander and tube sheet hole surface best suited to make gas-tight condensers at Kelvinator

CONSIDERABLE thought has been given at Kelvinator toward finding a better way of attaching copper tubes to cast iron and forged steel condenser tube sheets. Although this construction seemed simple, it was not easy by known methods to produce the desired joint. The ideal joint must not only be gas tight under high refrigerant pressures but must withstand continued vibration, shock and sudden temperature change. It should be free from scale and should not restrict flow of water through the tube.

According to standard practice in the industry at the time, the original design called for brazing the copper tubing into the tube sheet. However, some difficulty was experienced by vendors in making the brazed joints hold. The intense heat required to braze a tube often set up stresses in other previously brazed tubes which broke them loose. Furthermore, in brazing a joint, it is likely that scale will be produced on the inside of the copper tube. Because of these difficulties, the need of a more satisfactory way of holding tubes was felt.

A new method tried was that of expanding solder-dripped copper tubes into the tube sheet, using an expander similar to that commonly used in "rolling in" steel boiler tubes. After expanding, the joints were heated to melt the soft solder. It was thought that the solder would seal and strengthen the joint, but such did not prove to be the case. The heat required to melt the solder was usually sufficient to relieve the stresses in the copper tubes set up by expanding. This, of course, counteracted the effect of expanding and tended to produce weak and leaky joints.

Up to that time, the vendors who made these condensers had not considered the amount of clearance between tube and tube sheet of particular importance in an expanded joint. For the next step it was decided to hold definite clearances between copper tube and tube sheets of the expanded joints and to use untinned copper tubing. After expanding, the joints were not heated as the previous ones had been and so the stresses in the tubes and tube sheets were not destroyed. A heavy multiple-tube condenser of this type was severely tested and the results were satisfactory. First it was dropped from a four-foot bench to the floor and then turned end over end several times. This failed to produce any leaks. It was then tested to determine the effect of sudden heat and cold on the joints. Live steam and cold water were alternately passed through the condenser and still no leaks were caused.

Such a degree of success was obtained by expanding tubes in these large commercial condensers that it was decided to go to this method for the entire line of commercial water-cooled condensers.

We were unable to find any published information in regard to expanding copper tubes into iron tube sheets. In order to find out the procedure for making the best possible expanded joints, extensive tests had to be made. Through these tests were determined the clearance between tube and tube sheet, best surface for tube sheet hole, proper amount of tube elongation and type of expander.

Test Procedure

In the following tests, sample cast-iron tube sheets 3 in. in diameter and $\frac{1}{8}$ in. thick were used. In the center of each tube sheet a bearingized, reamed, or fly-cut tube hole was provided, $\frac{3}{4}$ in. in diameter. Soft, $\frac{3}{4}$ in. copper tubes, having 0.035 in. wall thickness, were expanded into the tube sheets. The tubes were selected to give a clearance between tube and tube sheet of 0.005 in. Tests were made with an expander having a taper of 0.023 in. per in. and then duplicated with a parallel expander. Tube elongation, axially, caused by "rolling in," was measured and taken as an indication of the amount of tube expansion. This tube elongation was measured by means of a "Last Word" indicator clamped to the tube, with the point resting on the tube sheet. This dial indicator is similar to that described by F. F. Fisher and C. T. Cope (A.S.M.E. *Transactions* May, 1935). In "rolling in" all tubes, the position of the expander shaft was measured and recorded for every 0.001 in. progressively that the tubes were elongated.

In testing the expanded joints, all air pressure tests were made at 225 lb.

per sq.in. and all SO_2 tests at 200 lb. per sq.in. In the following, by "inside air test" is meant that pressure was applied to the inside of the tube. "Outside air test" means that the pressure was applied to the outside of the tube, as would be the case in an actual receiver-condenser set-up. SO_2 pressure, in all cases, was applied to the inside of the tube.

In a preliminary test, nine tubes were expanded to give elongations of approximately 0.005 in. The expander had a taper of 0.023 in. per in. All three bearingized pieces were O.K. under inside air test and SO_2 test. All three reamed pieces leaked under inside air test, and two of the three also leaked under SO_2 test. Two of the three fly-cut pieces leaked under inside air test and one of the three also leaked under SO_2 test. It was possible to stop 40 per cent of these leaks by further expanding the tubes.

To test the strength of the joints, a hydrostatic slip test was used, applying the pressure to the inside of the tubes. The tube of a bearingized hole piece bursted at 300 lb. per sq.in. without any apparent joint failure. A bearingized, a reamed and a fly-cut piece, tested with a protecting sleeve, each withstood 5,000 lb. per sq.in. without any apparent failure of the expanded joints. Hydrostatic pressure was then applied to the outside surface of some tubes. The joint of a bearingized piece failed at about 2,200 lb. per sq.in. because of collapse of the tube. The joint of a reamed piece failed at about 1,700 lb. per sq.in. because of collapse of the tube. Other hydrostatic tests were made later.

Additional tests were made, still using the tapered expander, but with tube sheets of electric cast iron as specified for the receiver ends. Clearances between tubes and tube sheets of 0.005 in. were used. Three each of bearingized, reamed and fly-cut pieces were "rolled in" to give elongations of 0.005, 0.010, 0.015 and 0.020 in. Then a set of three reamed, three bearingized, and three fly-cut grooved hole pieces were rolled in. The grooves were $\frac{1}{8}$ in. wide and 0.010 in. deep. Tube elongations of 0.010 and 0.015 in. were used.

It will be noted that all bearingized pieces were O.K. under "inside" and "outside" air tests and SO_2 tests. Reamed and fly-cut pieces elongated 0.015 in. were also O.K. under all three tests. All of the plain hole reamed pieces whose tubes had been elongated 0.005, 0.010, or 0.020 in. leaked under the "inside" air pressure test. Fifty-five per cent of the corresponding fly-cut pieces leaked under the "inside" air test. None of the bearingized reamed or fly-cut grooved hole pieces leaked at all. Probably this was partly due to the favorable elongations used (0.010 and 0.015 in.) and partly to the effect of the grooves.

Parallel Expander Used

Similar tests were then made using a parallel expander. Tubes were expanded into bearingized, reamed and fly-cut plain hole pieces to give elongations of 0.005 and 0.010 in. Some fly-cut pieces were rolled in to give 0.015 in. elongation. Then a set of bearingized and of reamed, grooved hole pieces was expanded to give tube elongations of 0.005 and 0.010 in. Some fly-cut grooved hole pieces were rolled in to give elongations of 0.015.

All of the bearingized hole joints and fly-cut hole joints expanded with a parrallel expander were O.K. However, three of the reamed hole joints leaked. Upon examining the reamed holes, it appeared that they had been poorly reamed. It seemed quite difficult to obtain reamed hole tube sheets which were uniformly accurate enough to prevent leaks. If the reamer chattered, or holes were cut or round, or gouged out, leaks were more than likely to result.

Hydrostatic tests for joint failure were made on several tubes. Since the tubes collapse at 1,700 to 2,200 lb. per sq.in. it was necessary to pour solder into the tubes before testing the joints. It will be noted that fly-cut hole pieces were strongest, reamed next, and bearingized weakest against slip.

Grooved hole pieces were much stronger than plain hole pieces. A groove increases the strength of a bearingized piece, elongated 0.010 in. with a tapered expander, by about 27 per cent.

TESTS WITH TAPERED EXPANDER

Bearingized Hole In Cast Iron Tube Sheets

All Tube Surfaces cleaned with Crocus Cloth — "X" = Remaining distance which expander rod projects out when expansion is finished. — Expander Taper = .023 in./in.

Test Assy. No.	Cast Iron Tube Sheet	Copper Tubes O.D.	Clearance	Wall Thickness	Inches Elongation	"X"	225#/□" Ins. Air	225#/□" Outs. Air	200#/□" SO_2	Hydrostatic Failure Pressure
	Plain I.D.									
10	Hole .750	.745	.005	.035	.005	1 3/16"	O.K.	O.K.	O.K.	
11	" .750	.745	.005	.035	.005	1 5/32	O.K.	O.K.	O.K.	
12	" .750	.745	.005	.035	.005	1 5/32	O.K.	O.K.	O.K.	1800#/□" (External)
13	" .750	.745	.005	.035	.010	1 1/32	O.K.	O.K.	O.K.	
14	" .750	.745	.005	.035	.010	1 1/32	O.K.	O.K.	O.K.	
15	" .750	.745	.005	.035	.010	1 1/32	O.K.	O.K.	O.K.	2000#/□"
16	" .7505	.745	.0055	.035	.015	29/32	O.K.	O.K.	O.K.	
17	" .7505	.745	.0055	.035	.015	27/32	O.K.	O.K.	O.K.	
18	" .7505	.745	.0055	.035	.015	27/32	O.K.	O.K.	O.K.	2500#/□"
19	" .750	.745	.005	.035	.020	3/4	O.K.	O.K.	O.K.	1900#/□"
20	" .750	.745	.005	.035	.020	13/16	O.K.	O.K.	O.K.	
21	" .750	.745	.005	.035	.020	59/64	O.K.	O.K.	O.K.	1800#/□"
	Grooved									
22	Hole .750	.745	.005	.035	.015	7/8	O.K.	O.K.	O.K.	
23	" .750	.745	.005	.035	.010	31/32	O.K.	O.K.	O.K.	
24	" .750	.745	.005	.035	.010	61/64	O.K.	O.K.	O.K.	5400#/□"
	Plain	*Reamed Hole In Cast Iron Tube Sheets* (Same Expander Taper)								1900#/□"
25	Hole .750	.745	.005	.035	.005	1 5/16	Leak	O.K.	O.K.	(External)
26	" .750	.745	.005	.035	.005	1 5/32	"	O.K.	O.K.	
27	" .750	.745	.005	.035	.005	1 7/32	"	O.K.	O.K.	
28	" .751	.746	.005	.035	.010	31/32	Leak	O.K.	O.K.	2800#/□"
29	" .7515	.7455	.0065	.035	.010	1 3/64	Slight Leak	O.K.	O.K.	
30	" .752	.746	.006	.035	.010	.....	Leak	O.K.	O.K.	
31	" .750	.745	.005	.035	.015	59/64	O.K.	O.K.	O.K.	2900#/□"
32	" .7495	.745	.0045	.035	.015	31/32	O.K.	O.K.	O.K.	
33	" .750	.745	.005	.035	.015	15/16	O.K.	O.K.	O.K.	
34	" .7495	.745	.0045	.035	.020	27/32	Slight Leak	Leak	O.K.	2600#/□"
35	" .750	.745	.005	.035	.020	61/64	Leak	"	O.K.	
36	" .7495	.745	.0045	.035	.020	29/32	"	"	O.K.	
	Grooved									
37	Hole .7495	.745	.0045	.035	.015	57/64	O.K.	O.K.	O.K.	6400#/□"
38	" .750	.745	.005	.035	.010	1	O.K.	O.K.	O.K.	
39	" .7495	.745	.0045	.035	.010	1 1/8	O.K.	O.K.	O.K.	
	Plain I.D.	*Fly-Cut Hole In Cast Iron Tube Sheets* (Same Expander Taper)								2200#/□"
40	Hole .750	.745	.005	.035	.005	1 3/16"	Leak	O.K.	O.K.	(External)
41	" .750	.745	.005	.035	.005	1 3/16	"	Leak	O.K.	
42	" .750	.745	.005	.035	.005	1 9/32	O.K.	O.K.	O.K.	
43	" .750	.745	.005	.035	.010	1 1/8	Leak	O.K.	O.K.	2800#/□"
44	" .7505	.745	.0055	.035	.010	1 1/16	O.K.	O.K.	O.K.	
45	" .7505	.745	.0055	.035	.010	1 1/16	Leak	O.K.	O.K.	
46	" .7495	.745	.0045	.035	.015	63/64"	O.K.	O.K.	O.K.	3250#/□"
47	" .750	.745	.005	.035	.015	59/64	O.K.	O.K.	O.K.	
48	" .7495	.745	.0045	.035	.015	15/16	O.K.	O.K.	O.K.	

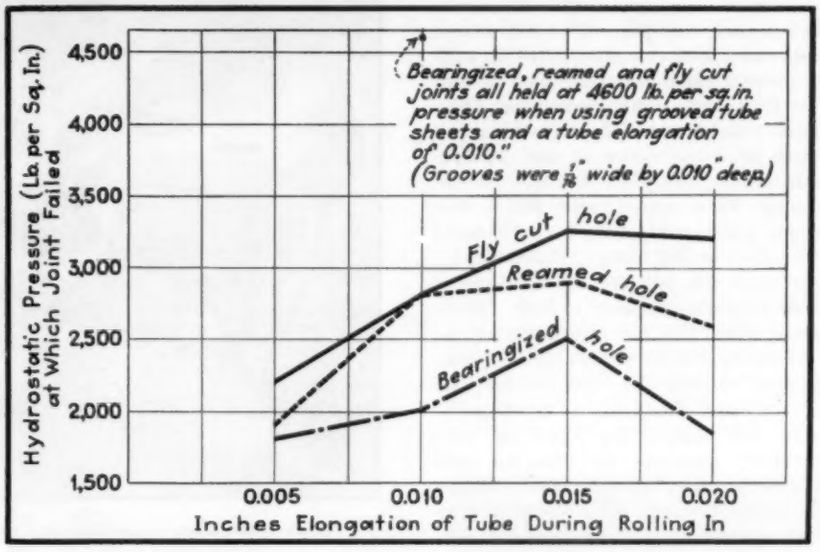
Per Cent Contact

A test was made to determine the relation between amount of elongation and per cent of possible surface contact between tube sheet and tube. This was done by examining tubes which had been forced by hydrostatic pressure from their tube sheets and measuring the length of the tube which had been in contact with the tube sheet.

For tubes expanded with a tapered expander (0.023 in. per in.):

Tube	Inches Elongated	% of Possible Surface Contact	
A.....	0.001	33	
D.....	0.005	66	
F.....	0.010	83	
G.....	0.015	100	Judging from surface appearance about the right amount of rolling.
H.....	0.020	100	Appears slightly over rolled.
I.....	0.031	100	Appears thin and over rolled Copper seems to scale.

For tubes expanded with a parallel expander it was found that 100 per cent contact exists shortly after the tube begins to elongate.



Comparative holding strength of joints formed by expanding copper tubing into tube sheets having bearingized, reamed or flycut holes. Note—Tube walls of soft copper are 0.035 in. thick; tube sheets, electric cast iron; tube sheet holes, 0.075 in. diameter; tube and sheet clearance, 0.005 in. hydrostatic test pressure was applied to the outside of the tubes

Test Assy. No.	Cast Iron Tube Sheet	Copper Tubes O.D.	Clearance	Wall Thickness	Inches Elongation	"X"	225#/□" Ins. Air	225#/□" Outs. Air	200#/□" SO	Hydrostatic Failure Pressure
49	" .7495	.745	.0045	.035	.020	63/64	O.K.	O.K.	O.K.	3200#/□"
50	" .7495	.745	.0045	.035	.020	63/64	Leak	Leak	O.K.	
51	" .7495	.745	.0045	.035	.020	57/64	O.K.	O.K.	O.K.	
52	Grooved Hole .7495	.745	.0045	.035	.015	55/64	O.K.	O.K.	O.K.	
53	" .7495	.745	.0045	.035	.010	1	O.K.	O.K.	O.K.	4900#/□"
54	" .7495	.745	.0045	.035	.010	1	O.K.	O.K.	O.K.	
	Plain I.D.	*Bearingized Hole In Cast Iron Tube Sheets* (Parallel Expander)							1500#/□"	
55	Hole .750	.745	.005	.035	.005	1 59/64	O.K.	O.K.	O.K.	(External)
61	" .7508	.745	.0058	.035	.005	1 15/16	O.K.	O.K.	O.K.	
62	" .7508	.745	.0058	.035	.005	1 31/32	O.K.	.....	O.K.	
63	" .7508	.745	.0058	.035	.005	1 31/32	O.K.	.....	O.K.	
58	" .750	.745	.005	.035	.010	1 61/64	O.K.	O.K.	O.K.	1500#/□"
64	" .7508	.745	.0058	.035	.010	1 29/32	O.K.	.....	O.K.	
65	" .7508	.745	.0058	.035	.010	1 7/8	O.K.	.....	O.K.	
66	" .7508	.745	.0058	.035	.010	1 55/64	O.K.	.....	O.K.	
67	Grooved Hole .7508	.745	.0058	.035	.005	1 31/32	O.K.	.....	O.K.	2500#/□"
68	" .7508	.745	.0058	.035	.005	1 31/32	O.K.	.....	O.K.	
69	" .7508	.745	.0058	.035	.005	1 63/64	O.K.	.....	O.K.	
70	" .7508	.745	.0058	.035	.010	1 27/32	O.K.	.....	O.K.	5700#/□"
71	" .7508	.745	.0058	.035	.010	1 29/32	O.K.	.....	O.K.	
72	" .7508	.745	.0058	.035	.010	1 57/64	O.K.	.....	O.K.	
	Plain	*Reamed Hole In Cast Iron Tube Sheets* (Parallel Expander)								
56	Hole .7498	.745	.0048	.035	.005	1 63/64	Leak	O.K.	O.K.	
73	" .7498	.745	.0048	.035	.005	2 1/32	O.K.	.....	O.K.	
74	" .7498	.745	.0048	.035	.005	1 63/64	O.K.	.....	O.K.	
75	" .7498	.745	.0048	.035	.005	2 1/32	O.K.	.....	O.K.	2100#/□" (External)
59	" .7496	.745	.0046	.035	.010	1 7/8	O.K.	O.K.	O.K.	2800#/□"
76	" .7498	.745	.0048	.035	.010	1 7/8	O.K.	.....	O.K.	
77	" .7498	.745	.0048	.035	.010	1 59/64	O.K.	.....	O.K.	
78	" .7498	.745	.0048	.035	.010	1 15/16	O.K.	.....	O.K.	
79	Grooved Hole .7498	.745	.0048	.035	.005	2 1/64	O.K.	.....	.....	
80	" .7498	.745	.0048	.035	.005	2 1/64	O.K.	.....	.....	
81	" .7498	.745	.0048	.035	.005	2 1/64	Leak	.....	O.K.	2200#/□"
82	" .7498	.745	.0048	.035	.010	1 59/64	O.K.	.....	.....	
83	" .7498	.745	.0048	.035	.010	1 63/64	Leak	.....	O.K.	3400#/□"
84	" .7498	.745	.0048	.035	.010	1 59/64	O.K.	.....	.....	
	Plain	*Fly-Cut Hole In Cast Iron Tube Sheets* (Parallel Expander)							2300#/□"	
57	Hole .7496	.745	.0046	.035	.005	2	O.K.	O.K.	O.K.	(External)
60	" .7496	.745	.0046	.035	.010	1 15/16	O.K.	O.K.	O.K.	2400#/□"
85	Plain Hole .7496	.745	.0046	.035	.015	1 59/64	O.K.	.....	O.K.	3200#/□"
86	" .7496	.745	.0046	.035	.015	1 49/64	O.K.	.....	O.K.	
87	" .7496	.745	.0046	.035	.015	1 55/64	O.K.	.....	O.K.	
88	Grooved Hole .750	.745	.005	.035	.015	1 23/32	O.K.	.....	.....	
89	" .7498	.745	.0048	.035	.015	1 25/32	O.K.	.....	.....	7400#/□"
90	" .7498	.745	.0048	.035	.015	1 53/64	O.K.	.....	.....	

Effect of Temperature

One each of bearingized, reamed and fly-cut pieces having elongations of 0.005, 0.010, 0.010 grooved hole, 0.015 and 0.020 in. were tested to determine the effect of temperature change on the expanded joints. The pieces were cooled from 72 to –6 F. by submerging in a brine solution, and while in the brine, were tested under 225 lbs. per sq. in. air pressure applied inside the tubes. None of the pieces which were O. K. at room temperature were caused to leak by this temperature change. (One of the pieces leaked at room temperature, also at –6 and at 212 F.)

A bearingized piece which had been elongated 0.005 in. was then tested. Six times the test assembly was alternately heated above 212 and quenched in 0 F. brine. Each time the joint was tested under 225 lbs. per sq. in. internal air pressure and found O. K.

Two regular production coils of ½-in. tubing were expanded into a receiver end, and no leaks were found. The joints were then heated with a gas torch to make solder adhere to the cast iron and copper. When re-tested, one of the four joints leaked quite badly. However, the leak was stopped by re-expanding.

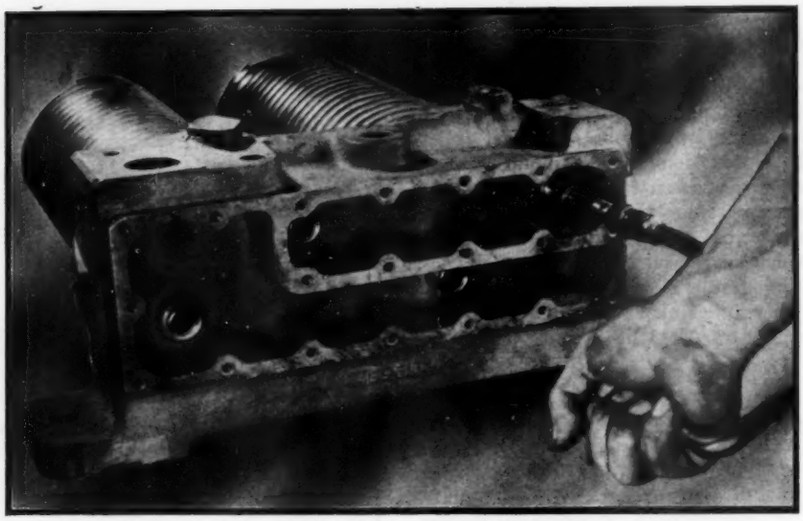
A reamed hole piece (No. 76) and a bearingized hole piece (No. 64) whose tubes had been elongated 0.010 in. with a parallel expander were then tested. To start with, both pieces were O.K. Each tube sheet was heated with a gas torch to cause solder to tin the cast iron around the joints but not on the joints. When rested under 225 lb. per sq.in. inside air pressure, the reamed hole joint leaked badly. Under 225 lb. per sq.in. air pressure the bearingized hole joint did not seem to leak. However, when the air pressure was increased to 275 lb. per sq.in., the joint slipped, causing the tube to blow out of the tube sheet. It is most probable that heating the joints to temperatures necessary for soldering with ordinary solder would cause serious damage. Heating the copper tube to high temperatures undoubtedly permits it to anneal somewhat, relieving the stresses set up in the joint by expanding, and thereby spoiling the joint.

Precautions Necessary

It has been observed that certain precautions should be taken in expanding copper tubing into cast iron sheets to obtain best results.

1. The expander should be kept free from copper and cast iron particles. The tendency for particles to collect in the expander depends considerably on the expander design.
2. Copper tube surfaces should not have deep scratches or other marks.
3. The cast iron tube sheets should not be porous and the tube holes should be properly machined.
4. The tube sheet hole and tube dimensions should be held closely to the specified size. Tubes should be as nearly round as possible.
5. The tube surface should be clean.

All tests which have been made show that a bearingized tube sheet hole is much superior to a reamed or fly-cut hole as far as leaks are concerned. In fact, no leaks whatsoever have been found in any joints having bearingized hole tube sheets. Bearingized hole joints seem to be weaker against slip than either reamed or fly cut. However, this appears to be of lesser importance since the hydrostatic pressure at which bearingized joints slip is about the same as the collapsing pressure of the tubes. Fly-cut hole joints are next to best to bearingized as far as leaks are concerned and are somewhat stronger against slip than reamed hole or bearingized hole pieces. Reamed hole joints apparently are the most undesirable since they seem undependable. Unless the holes are carefully reamed, leaks are likely to result.



Copper tubes are expanded into the condenser tube sheet on a production job in accordance with methods determined by test

The most noticeable effect of a groove in the tube sheet hole has been to increase the strength of the joint In general, a groove more than doubles the pressure at which the joint will fail due to slip.

Further, a groove in the tube sheet hole tends to make the joint more leak-proof. (For instance, all three plain, reamed hole, pieces elongated 0.010 in. with the tapered expander were found to leak. But two other pieces, identical except for grooves in the tube sheets, were both found O.K. The same effect of grooves in preventing leaks was found when fly cut hole pieces were tested.)

With an expander tapered 0.023 in. per in. a tube elongation of 0.015 in. gave best results. None of the joints whose tubes were elongated this amount were found to leak. For a parallel expander a tube elongation of about 0.010 in. seems about right, considering strength of joints and appearance of the inner surface of the tubes. The correct amount of tube elongation to prevent leaks is much less critical with a parallel expander than it is with a tapered expander.

Tests show that sudden temperature changes between 0 and slightly above 212 F. will not damage the joints. However, heating the joints to high temperatures is quite certain to cause leaks.

Ideal Joint Specified

From the above tests Kelvinator engineers decided that the ideal joint would be made as follows:

The diameter of the tube sheet hole would exceed the outer diameter of the tubing by 0.005 in. The tube sheet hole should be round, smooth and free from defects. For tube diameters up to ¾ in. it seemed advisable to use cast iron tube sheets no less than 1 in. thick. Copper tubing should be round, and uniform with a wall thickness of 0.035 in.

The tube sheet holes would be *bearingized* and *grooved* and the tubes would be expanded with a *parallel expander* until the tubes had been elongated about 0.010 in.

Large Sheets or Welds?

Butt welding of sheets, such as are used in automobile bodies, is now being done with an accuracy that was impossible a few years ago. In fact this advance may have an effect on the rolling of the steel sheets themselves. New body designs call for large sheets for roofs and back panels. When made in one piece this construction takes very large sheets, and dies and presses must be both large and expensive. Further, the loss due to spoilage runs up to 25 per cent or more.

Some engineers are asking if it is not cheaper to use smaller pieces and weld them together. They feel that the lower cost of sheets, of dies and presses, not to mention spoilage, will more than pay for the welding, plus the cost of trimming the flash.

How's Your BALANCE?

Grinding wheel, not bank, balance will add to a plant's credit for quality

FRED B. JACOBS

MOST people probably use care in storing and handling grinding wheels, especially after a few experiences in having them crack from seemingly inconsequential bumps or falls. But how many of them exercise any supervision over the method of mounting wheels, particularly those for cylindrical grinding jobs?

With a large, heavy wheel there is

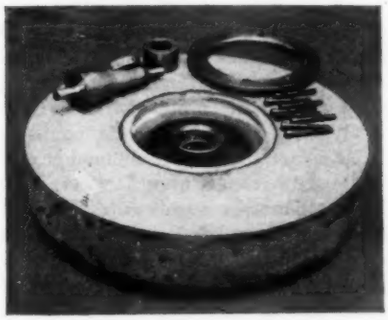


Fig. 1—Blotting paper is used between the wheel and flanges of both sides, and the screws are drawn tightly but not forced

likely to be an out-of-balance condition when applied to the machine, unless the wheel and its holder are balanced during mounting. The question may be asked "Why are not grinding wheels in perfect balance as they come from the manufacturer?" A few are, but others are out of balance by a slight amount. The reason is that a wheel is made from a mixture of materials—manufactured alumina and bonding material—and may be a little more dense in some spots than in others. Of course, wheels are selected by the maker for unbalance, and of those passed the ones slightly out of true balance come within reasonable limits for final balancing by the user.

It is important to have heavy wheels in true balance, because otherwise they cannot be relied upon to produce accurate or smooth work. An out-of-balance wheel throws a heavy strain on the machine bearings, sets up vibration detrimental to machine and work, and may even fracture because of the internal stresses arising from unbalanced centrifugal forces.

For these reasons users of large numbers of wheels have given attention to balancing before use in production, but the method is simple and

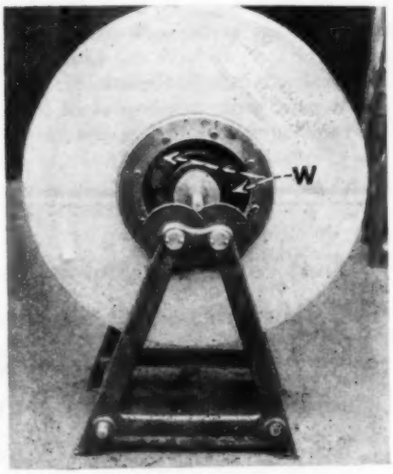


Fig. 2—A roller stand is a very sensitive device for checking the condition of unbalance; blocks W are used in the adjustment

can be adopted by any shop. The practice at the Eaton Manufacturing Company is a good example. Here, when a wheel is taken from stock, the procedure is as follows: The wheel is placed over the wheel holder, with a piece of blotting paper between the flange on the holder and the wheel. Fig. 1 shows a 30 by 5-in. face wheel with a 12-in. hole placed over a holder which rests on the floor. Resting on the wheel is the other flange and the eight hollow-head capscrews for securing the flange. This flange is also put in place with a piece of blotting paper between it and the wheel. The eight screws are drawn up snug with the correct size

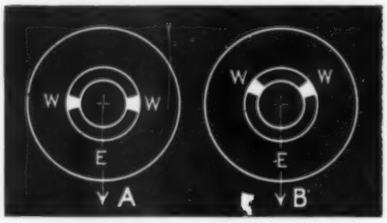


Fig. 3—To overcome unbalance the blocks W are adjusted outward opposite the heavy side of the wheel

of wrench, but they are not forced with a piece of pipe.

The next step is to balance the wheel. Eaton's method is to put the mounted wheel on an arbor and test on a rotary balancing stand, as shown in Fig. 2. This is a very sensitive method. The rollers, on which the arbor rests, are furnished with ball bearings so that they turn easily. Rolling contact between the arbor and the rollers also causes little friction. Thus, through the attraction of gravity the heavy side of the wheel will come to rest in the down position.

Inside the holder can be seen two balancing blocks *W*, and the principle is shown by Fig. 3. At *A* the wheel is shown as it came to rest with the heavy side downward. Balancing blocks *W* are located on the horizontal centerline and therefore are neutral in effect. Now if these balancing blocks are moved downward, that is toward the heavy side of the wheel, they will simply increase the out-of-balance condition. But if they are moved above the centerline as at *C* they will tend to decrease the out-of-balance condition. By careful adjustment in this direction a point will be found where they will just offset the effect of the heavy side, and the wheel will be found to be in balance. Thus, when the wheel is rotated at high

speed the centrifugal force set up by the dense portion of the wheel is offset by the opposing centrifugal forces set up by the weights. The type of wheel holder shown is used on nearly all cylindrical grinders at the plant as it furnishes a convenient and accurate means for balancing.

Certain types of wheels do not need balancing. An example is shown in Fig. 4 where a sectional wheel is being mounted for a Blanchard grinder. The wheels make up to a diameter of 18 in., being composed of eight blocks 6 in. deep. It is a comparatively simple matter for the grinding wheel manufacturer to make any number of these blocks of like size and with not enough variation in weight to cause an out-of-balance condition. Even though the wheel were slightly out of balance, the unbalanced centrifugal force would be in the horizontal plane and would not have appreciable affect.

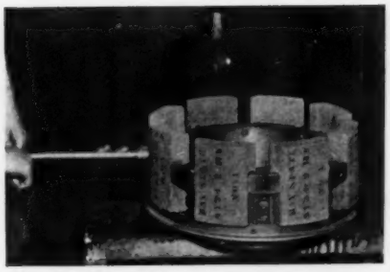


Fig. 4 — Most segmental wheels need not be balanced, because the segments can be manufactured with uniform density

Large quantities of small wheels are used at the Eaton plant for internal grinding, but such wheels do not ordinarily present balancing problems. As they are comparatively small any vibration caused by an out-of-balance condition is absorbed by the mass of the heavy grinding-machine spindle. Small wheels are also used for precision sharpening, but they are seldom over 8 in. in diameter and thus rarely cause trouble.

Averages Fool the Old Man

JOHN R. GODFREY

Old Man Johnson had been reading the Eastman report on railroad machine equipment and was all pepped up about it when I dropped in on him awhile back.

"Averages are funny birds, Godfrey," says he. "You can make them tell you a lot of different stories. I've been jarred a bit lately in two directions. First I ran across an old pal who runs a small shop in Ohio, so of course I asked him how things were coming.

" 'Fine,' says he. 'Business is booming. Had to increase my force 50 per cent last week.' "

" 'And how many men have you now, Bill?'

" 'Three,' says Bill.

"That 50 per cent sounded just as big as though his shop was as big as Ford's. Bill may be happier as it is. But it opened my eyes as to percentages. The next jolt—and here's why I was interested in that Eastman report—was my own shop.

"I thought we'd bought a lot of new machines and ought to be sitting pretty. Sort of figured on a few hundred in extra dividends this year. And then Tom spoiled it by saying we'd just got to buy some new lathes.

"You're crazy, Tom," says I. "Here's that report of the expert figure juggler you hired which shows that the average age of our machines is only seven years. What more do you want—gold plated lathes?

" 'Seven years my eye, Dad,' says Tom. 'That seven years refers to the whole shop. Even if it meant lathes, some of them might be twice that age if we had one or two new ones. As a matter of fact we have one lathe that I'll bet Noah had in the ark. If he'd had a pair, we'd sure be out of luck. We've got quite a lot of new machines but our lathes are a mess—on the whole. Most of 'em belong in the cupola.

" 'Our engine lathe department hasn't had but one addition since the war. Averages look nice on a report to show a board of directors, most of 'em don't know a thing about machines, or averages either. But you can lose a lot of money on old lathes, and that's what I want to stop. We've got to have some modern lathes, Dad—even if they only averaged seven years, they would still be out of date.'

"When Tom makes up his mind to have something in the shop, he generally gets it. He'd rather have new lathes than win a golf cup. And at that, Godfrey, I guess I'm lucky to pass up a dividend in that way, rather than spend it on getting a son out of some sort of a scrape.

"But don't forget that you can get awfully fooled on averages, Godfrey."

Tool room equipment, tool room practice, tool room system will occupy all of the next number of *American Machinist*. Upwards of 50 modern tool rooms were studied by the staff to get the information for this Tool Room Modernization Number. The leading article is a comprehensive description of the Buick tool room

RESEARCH

for Small Shops

TO MOST people research raises visions of expensive laboratories, elaborate equipment and a staff of chemists, metallurgists and scientists of various descriptions. Only large institutions can afford such comprehensive establishments. In reality research is nothing of the sort. Webster defines it as a "careful or critical examination in seeking facts or principles," which lays it in the lap of every shop executive. The size of his shop or plant is not important.

According to C. F. Kettering, only large concerns can afford *not* to carry on research, meaning that their reserves could carry them longer on a non-paying basis. A small firm with live management that appreciates the value of research has many times proved a worthy competitor for much larger concerns.

Research is simply trying to find new products, better materials, improvements in the old product or better ways of making it. Companies that fail to study these possibilities constantly sooner or later fall by the wayside.

In the progressive small shop the owner is always on the lookout for new things to make, or for ways of improving quality or of lowering costs, or both, but probably without thinking of it as research at all. Granted the necessity of research under whatever name, it is important to know how much can be spent on this work. For while it must and will eventually pay dividends, if properly conducted, companies whose resources are limited must not spend too much in any one department.

One of the companies of moderate size, which has recognized the necessity both for research and for making it pay its way, is the Leeds & Northrup Company. Through the courtesy of Morris E. Leeds and several of his associates this comprehensive outline of the method they have found advantageous is presented.

As stated previously, research is undertaken not only for developing new products, but also for improving those which have proved satisfactory in the past. In connection with new products, it is interesting to note that it is a general principle of this company not to enter any field which, in their judgment, is being covered satisfactorily at present. Their research activities at the present time are confined to twelve classifications: (1) Recorders, (2) automatic control, (3) temperature measuring appliances, (4) furnaces, (5) electro-chemical apparatus, (6) combustion control instruments, (7) flow measuring and control, (8) pressure measurement and control, (9) frequency and load measuring apparatus, (10) direct current laboratory apparatus, (11) alternating current laboratory apparatus, (12) miscellaneous.

The Development Committee

All research projects are acted upon by a development committee consisting of the president, vice-president of sales, vice-president of engineering and research, research director, chief engineer, treasurer, factory manager and the head of the department of market extension. This committee passes on the advisability of new projects and receives reports of all that are under way. These reports are comprehensive and cover all points involved, including finances and results. Five copies of each new order are made, and go to the research, engineering, patent, market extension and tooling departments.

The cost of research alone does not represent the whole expense involved in a new item of manufacture or in an improvement on an old one. In addition to research, there is the cost of engineering, of patents, of market extension activities and of the tools necessary for its manufacture. It is for this reason that copies of each new order go to each of the divisions named. Proportionate cost of these divisions differ with the item in question, but a careful check is kept of each division as well as of the total.

The Research Budget

How much should be spent on research is largely a matter of opinion and varies widely according to the concern and its product. One suggestion is that the budget for research alone be made similar to that for advertising, which frequently ranges from two to five per cent of the total sales. Apportionment of the money available will also vary, the Leeds & Northrup percentages for a recent year being approximately 73 per cent for new products, 13 per cent for improving the quality of products already being manufactured and the balance for miscellaneous projects.

Space and personnel devoted to research are also of interest. In this plant the staff of the Research Department, not including those in other departments involved in development work, numbers twelve men, with something over 14,000 sq.ft. of floor space to work in. This does not include the special shop in which experimental work is done, but only the laboratories in which the research is done and the resulting instruments are tested. This experimental shop covers about 7,000 sq.ft.

Costs of all research activities are carefully kept by each of the divisions named, the total being charged against the project, which may be a new item of manufacture or an improvement of one already on the list. If a new item these costs must be more than balanced by the eventual net income if the item is to be a profitable addition to the firm's line of products. If an improvement, the results may have to be viewed from a somewhat different standpoint, since such work is often necessary to maintain sales at a profitable point.

Impatience on the part of the sales department to spring new products on the customer, or to dilate on improvements, makes it necessary for those in charge of research to have complete control until the new or improved product is ready for marketing. Occasions arise where it seems advisable to let a new design go out to certain customers before it is formally put on the market. This may help a good customer out of a difficult situation and at the same time afford the opportunity for a real working test away from the watchful eyes of those interested in its success. Cases of this kind require the special permission of the vice-president in charge of research and engineering to allow the instrument to go out of the factory. With the engineering and manufacturing departments represented on the Development Committee, engineering design and manufacturing methods are developed before the project passes out of the hands of the Committee.

Constant improvement is necessary for the existence of any business. Research is necessary whether we call it by that name or not. The method outlined has worked out well for the Leeds & Northrup Company and can doubtless be used as a basis by many other companies.

APPRENTICESHIP PAYS

It pays the worker by providing him with a trade; it pays the employer by setting up a source of loyal key men; and it pays the industry by training potential leaders thoroughly familiar with its problems from top to bottom

J. E. GOSS

Employment Manager, Brown & Sharpe Manufacturing Company

IT IS A simple matter to learn about apprenticeship costs, but no business man should stop at the debit side of the ledger. It is an entirely different matter to set down the credit side and to strike a balance. An apprentice, who later becomes an efficient works manager, superintendent, department head, salesman, or a competent, loyal mechanic, may eventually put into the discard any balance sheet we might write during his training.

Only when we have done well with apprenticeship and carried it on long enough to see the results, can we say to our own satisfaction whether or not it is good business. We invest millions of dollars in our public schools, yet we have no exact means of knowing how well they pay. We know only that, in a general way, education is good for all concerned, and so we continue to pay for it and in ever increasing amounts.

The business of the Brown & Sharpe Manufacturing Company was founded 103 years ago, and ever since the early days apprentices have been trained in the works. A great many of the men who learned a trade here become leaders. They are now in positions, here and elsewhere, of a managerial nature, charged with responsibilities, which include, primarily, the maintaining and the betterment of profits.

Not even an approximation can be made as to the savings that have been effected by these men. We do know, however, that we need them for the conduct of our business.

Many men who served an apprenticeship here are now on our "Long Service Roll", having been with the company a total of 25 years or more.

Recently we made a summary of the men now with us, who have completed their training during the last ten years, and this was what we found among them: one department foreman, three assistant department foremen, twenty sub-foremen, nine salesmen, four machine demonstrators, four timestudy men, one estimator, two special investigators, two instructors of apprentices, three assistant mechanical engineers, one assistant on patent work.

In addition to these are many machinists, toolmakers, draftsmen, molders, patternmakers, coremakers and automatic screw machine operators who have either continued to work here following their apprenticeship or have been re-employed.

These men know not only their respective trades but our methods. They make up the backbone of the working force.

Whether or not apprenticeship pays depends, in considerable measure, on whether or not a large enough percentage remain with the organization in which they were trained. In this same ten-year period we find that 54 per cent are now with us.

So far as we know, most of the others are following their trades, and some of these are in what might be called key positions in respect to recommending our product for use in the shop where they now work.

Talking Shop

Du Pont's R. & H. Chemicals department showed a step forward in zinc plating by adding brightening compound to the plating solution thus eliminating an extra dip.

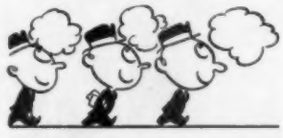
Metal Show

Bigger and better is the only way to describe the National Metal Show held last month in Cleveland. Housed in the Public Auditorium, where machine tool builders displayed their wares in 1935, this exhibit formed a striking picture of the interdependence of the two major groups of equipment used by the metal-working industry. More and more are metals being processed with an eye to the machining and heat-treating operations they will undergo in the machine shop. More and more are furnaces, welding and finishing outfits being built as machines to fit into production lines.

Judging from their increased attractiveness booths received more artistic attention than ever before. Special mention goes to Union Carbide and to steel's big three—U. S. Bethlehem and Republic.

Gas Minded

In grouping their exhibits, makers of equipment and accessories using gas did a smart thing in a pleasing way. Electric heating has its place, but such displays as the Gas Section play a big part in keeping industry



gas conscious. Ability of gas furnace makers to adapt their designs for controlled atmospheres and uniform heat was highly convincing.

Maybe it was foot fatigue or the lure of the silver screen, but booths showing industrial movies were kept well filled. Presentations were well planned and informative.

Brush and Salts

Brush plating was among the new processes shown at the Show. Nickel and Chromium Products Company demonstrated this, together with its line of salts designed to reduce polishing.

Metal Men

There were at least two robots at the show. At the beginning of the entry arcade the Great Lakes Steel Corporation's mechanical man circu-

lated among the incoming visitors. U. S. Steel's robot moved on sort of a merry-go-round past twelve illustrated panels and in a mechanical voice described each one.

Hard facing came in for attention in the displays of three sponsors—Stellite, Stoody and Colmonoy. From the growing interest in this process it is apparent that it has something industry needs.

New Hardening

One of the popular booths was that of the Ohio Crankshaft Company which featured the Tocco method of hardening. Applied to crankshafts, this automatic induction process heated and quenched the bearing surfaces in successive cycles without disturbing the crank arms. As an innovation in selective hardening, the demonstration well deserved the attention it got.

Another good display was the Jones and Laughlin model furnace which showed the pouring side of a miniature open hearth in operation.

Testing Trends

Inspection and testing instruments reflected departures from past practice with special emphasis on fatigue measurement. G. N. Krause and Baldwin-Southwark both displayed devices designed for fatigue cycles in excess of 10,000 per min.

The technical sessions of all sponsor societies were packed, and with good reason—those delivering papers had something worth listening to. Another reason was the marked improvement in the oral delivery of the papers. James P. Gill, to name one, was a pleasure to hear giving his Campbell memorial lecture.

Soft Speaker

Bob Archer, retiring American Society for Metals president, who acted as chairman at that organization's annual banquet, used the radio crooner's technique in introducing the speakers. Keeping his voice low and mouth close to the mike of the public address system, he gave a perfect demonstration of effortless oratory.

The A.S.M. past presidents came through 100 per cent. Every one of the thirteen was present at the Congress.

Sauveur to Jeffries to Chapin

It took a triple play to deliver the Albert Sauveur Achievement Award. Dr. Sauveur, first recipient, made the

presentation, and Dr. Zay Jeffries, second recipient, introduced the third recipient, William R. Chapin.

Not least popular of the week's events was the Welding Society Smoker, augmented as it was with beer and talent from the side shows of the Great Lakes Exposition.

—The Editors.

DIE DESIGN and DIE MAKING

XVI—Other operations such as forming and blanking can frequently be combined with drawing in single dies in order to reduce tool and labor costs

E. G. MARSHALL
Master Mechanic, Charleston Works, The American Fork & Hoe Company

A COMBINATION forming and drawing die is illustrated by Fig. 70. The top panel of an adding machine is produced by these tools, one end of the blank having a double right-angle form with a dome drawn nearby. The blank, which is 1/16 in. thick, is located by pins on the sides and the back end and by flat springs at the front. Thus, the blank is caused to lie at an angle with the top face of the lower die block. When the upper member moves down, it hits the blank near the large radius *A* and then continues down to form the metal over both the large radii *A* and *B*. At this point the upper member bottoms and pinches the metal. While the upper member dwells the plunger moves down and draws the dome in the center.

Dead-soft rolled skin material must be used for work of this character. Moreover, the radius on the lower die block must be stoned very smooth and the set-up man must be very careful in setting the amount of pinching of the blank in order to avoid wrinkles and fractures.

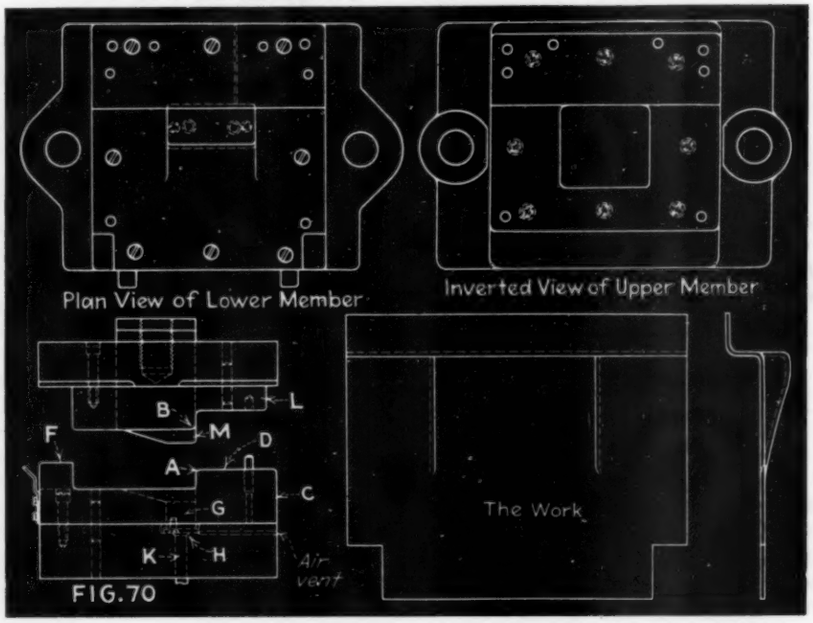
Die block *C* is made of wear-resisting, water-hardening tool steel. The top central portion is machined to the desired shape of the part. The raised section *D* at the rear forms the part, while the raised sections *F* at the front act as heels to back up the punch. A hole is machined in the center to suit the shape of the dome, and where the square section of the dome comes the hole is machined right through the die block, so that a movable member can be used as an ejector. A radius is used all around the depression in the die block so that the metal can flow over in drawing. The lower die block is then screwed and doweled to the lower member of the sub press.

The movable member *G* is made of tool steel and is machined to a snug sliding fit in the hole in the die block. The retaining plate *H* is likewise made of tool steel and is attached to the bottom of *G* with flat head screws. The top of *G* is ground in assembly to suit the height of the dome and also so that it will bottom and iron out the part. Both *G* and *H* are operated by the knockout pins *K* in the lower member casting. These pins are operated from the positive knockout in the punch press, and they are made of drill rod and hardened.

The upper die block *L* is made of water-hardening wear-resisting tool steel and hardened and ground. It is screwed and doweled to the upper member. The lower face is machined to iron out the part all over on top of the lower die block, and the center is machined out to be a snug sliding fit around the dome-drawing plunger *M*. The working surfaces of both die blocks should be very smooth to allow the metal to flow freely where necessary. The plunger *M* is made of tool steel and the lower end is machined to the size of the inside of the dome, while the upper end is machined to fit the double-action plunger.

A double-acting drawing die for

Fig. 70—After the upper member makes the double right-angle form, the plunger moves down and draws the dome



drawing a rectangular dome in 1/16-in. cold-rolled steel is shown in Fig. 71. This dome is 2 1/2 in. wide by 6 in. long by 2 1/4 in. The sides of the dome are practically straight while the ends are distinctly tapering.

The blank is located on the lower die by four nest plates. When the press is tripped the cams on the camshaft drive the ram and upper member down. The pressure ring on the upper member contacts the stock and applies enough pressure to hold the metal back in the draw and prevent wrinkles. As the dwell on the cams hold the pressure ring, the crankshaft moves the center plunger down and draws the dome.

A standard sub press without any shank was selected for this die. The lower die block *A* is attached to the lower member with screws and dowels. It is made of water-hardening, wear-resisting tool steel and is hardened and ground. Nest plates *B* are made of cold-rolled steel and casehardened. The center of the die block is machined for the inserts that do the actual drawing.

Inserts Save Time

By making the die block and inserts in several pieces a lot of time can be saved in machining. The walls in the die opening are made straight and at right angles to the top of the die, and by making these walls correctly time can be saved in fitting the inserts.

Four inserts *C* and *D*, (two of each) are made a drive fit in die block *A*. Wear-resisting, water-hardening tool steel is selected for these parts. They are held in position by the screws in the die block and in the lower sub-press casting. After assembly the top of the inserts and the die block are ground flush and lapped smooth. It is well to turn the assembly over and take a light grinding cut over the bottom to get a flat surface. The insides of the inserts are machined to the outer size of the dome. In the center is left room for the lower knockout plate *F*, which is also made of tool steel and hardened. A dowel driven in the plate and sliding in the casting prevents the plate from turning.

Pressure ring *G* on the upper member is screwed and doweled in place. It is made of wear-resisting tool steel and hardened and ground. The lower surface is ground and lapped smooth so as not to mark the stock as it flows under. The center is machined a snug sliding fit around the plunger.

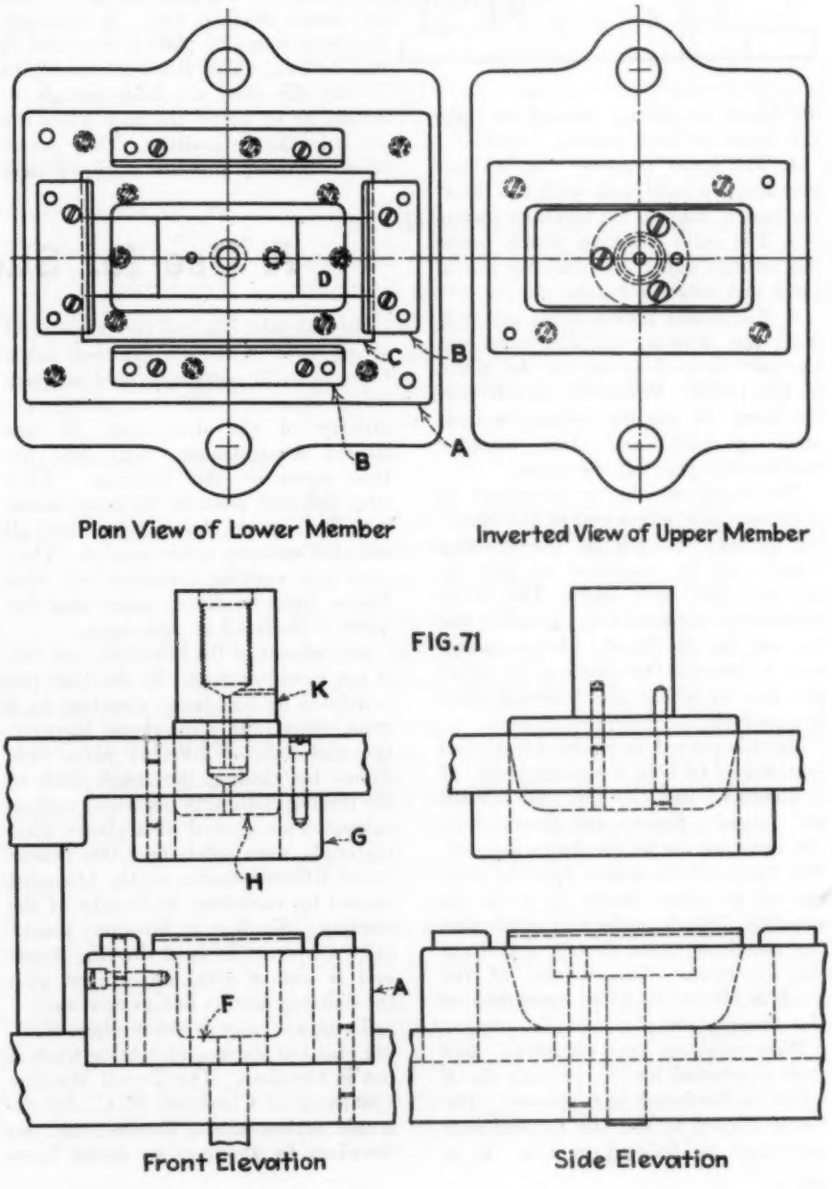
Drawing plunger *H* has the lower end shaped to the inside of the finished dome. The upper end is attached to the adapter *K* with screws and dowels, and the turned end of *K* helps to locate the plunger. Tool steel, hardened and ground, is used for the plunger, while machine steel is employed for the adapter.

A die designed to draw and then to trim or blank the part is shown in Fig. 72. The part is of the shape shown in the plan view of the die block and the height of the draw can be seen in the end view. Strip stock, 0.065 in. thick, being soft cold-rolled steel is employed. The stock is guided on the sides by pins and is registered by a solid stop pin. In the open position, the forming die is flush with the blanking die and the push-off pins are flush with both dies. On the upper member the pressure ring, which is the blanking punch, is flush with the bottom of the forming punch.

The sequence of operations is:

1. The stripper on the upper member hits the stock.
2. The pressure ring hits the stock.
3. The drawing punch moves down and makes the draw while the pressure ring keeps wrinkles out of the stock. The spring under the forming

Fig. 71—Four wear-resisting inserts line the die cavity. These inserts, as well as the pressure ring, are ground and lapped to gain smooth surfaces over which the stock can flow freely and not be marked



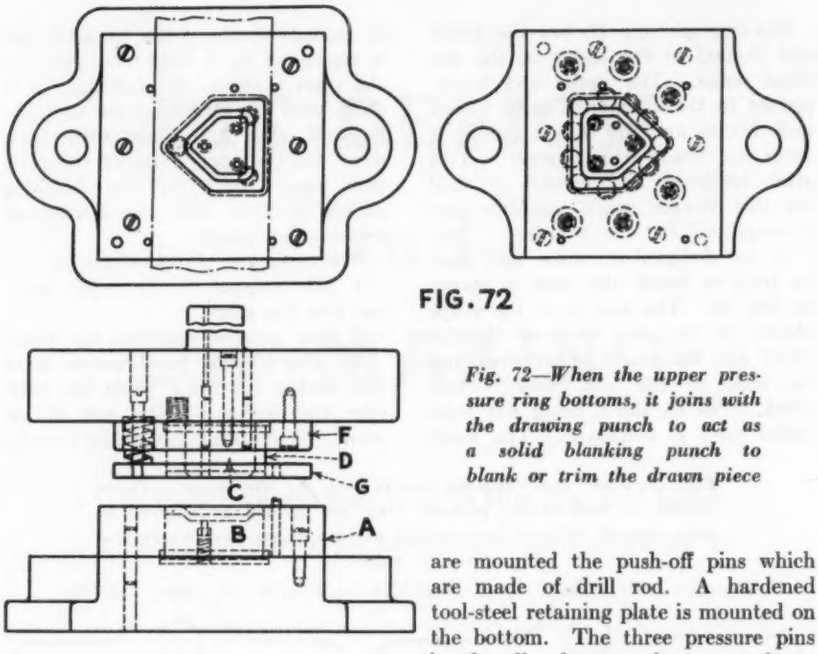


FIG. 72

Fig. 72—When the upper pressure ring bottoms, it joins with the drawing punch to act as a solid blanking punch to blank or trim the drawn piece

die must be strong enough to take the draw without moving down.

4. The upper pressure ring bottoms and forms a solid unit with the drawing punch, making the blanking punch.

5. The solid blanking punch forces the springs under the drawing die to yield and cuts the blank.

6. The punch moves down and bottoms the drawing die and irons out the part as well as setting the strain in the metal. When the punch rises the parts of the die return to their open position and the operator brushes the part off the press.

The upper member is sharpened by grinding the working end of the blanking punch. Length of the drawing punch can be shortened to suit by grinding the back end. The lower member is sharpened by grinding the top of the die block. When necessary to shorten the drawing die, grind the bottom where the retaining plate is attached.

Blanking die *A* is made of tool steel best suited to hold a cutting dege. It is hardened and the top and bottom are ground. Screws and dowels hold the blanking die to the lower member. The heads of the screws must be deep enough to allow plenty of room for grinding. Stock guide and stock pins are standard ¼-in. dowels driven in the die block. The bottom of the block is cleared to allow movement of the forming die.

Wear-resisting, non-distorting tool steel is selected for the forming die *B* which is hardened and ground. The top is shaped to suit the finished part and must be finished smooth. In it are mounted the push-off pins which are made of drill rod. A hardened tool-steel retaining plate is mounted on the bottom. The three pressure pins in the die shoe are long enough to extend ½ in. below the shoe when the die is in the up position. They are of large diameter and are made of drill rod and hardened. The drawing die should be a free sliding fit in the blanking die without perceptible shake.

Drawing punch *C* is made of wear-resisting tool steel and hardened. It is screwed and doweled to the upper member. Pressure ring *D* and the blanking punch are made of tool steel adapted to cutting. The ring is hardened and ground and the inside should be fitted to the drawing punch so as to obtain a sliding fit without shake. The outer periphery should be the shape of the finished blank. A ⅛-in. square heel on the back retains the ring in the guide block. Springs back of it in the punch holder provide pressure to keep out wrinkles.

Punch plate *F* retains the punch and guides it to some extent. This part is made of tool steel and hardened and ground. It is screwed and doweled to the upper member. Stripper *G* strips the scrap from around the punch. It is operated and attached by the springs and shoulder screws shown.

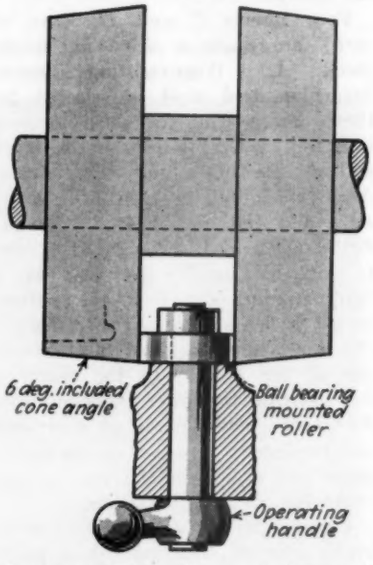
Part XVII of *Die Design and Die Making* will appear in an early number.

A Use for Shaded Drawings

Anyone who has had the privilege of seeing some of the old drawings made from 50 to 75 years ago could not help being impressed with two things, the artistry of the draftsman (it was spelled draughtsman then) and the time spent on the drawings. They were finished pictures in every sense, with brass parts shown yellow and all rounded surfaces nicely shaded. They were not working drawings but were drawn direct on heavy paper and frequently shellaced or varnished.

The advent of the blueprint, and this is not as old as might be thought, put a quietus on the fancy drawings to a great extent. In some shops, however, the materials of different parts were shown by shading the rough back of the tracing cloth with pencils of various colors. This showed at a glance what materials were used, and the pencils made different shades on the blueprint caused by variations in density of the shading. Shading is, however, practically a lost art in most drawing rooms and is not of vital importance with the different section linings now used.

There are cases however where shading still has its use, in catalog work if not in the shop. The Terrell Machine Company, of Charlotte, N. C., for example, makes catalog illustrations from drawings by shadings as shown herewith. For this purpose drawings are better than photographs as sections are easily shown. This is part of a textile machine, known as a "pull head," and the illustrations enable the user to see



what part he needs, to designate it clearly and to put it in place when he gets it. The work of shading is inexpensive but results in making it much easier for anyone to see just what is needed.

Editorials

AMERICAN MACHINIST ESTABLISHED 1877
VOLUME 80 NUMBER 24
K. H. CONDIT • F. H. COLVIN
EDITORS

INVESTMENT IN PROGRESS

TWO paragraphs in the courageous statement published by Alfred P. Sloan, General Motors president, as an advertisement in last week's newspapers should be taken to heart by every business and industrial executive.

Here are the paragraphs:

"A great opportunity exists of rebuilding America's productive facilities through replacing obsolete plants and machinery with modern equipment, thus offering a fundamental solution for the current problem of creating more jobs for more people."

"All depressions uncover opportunities of advancing the social and economic status of the community. The depression through which the world has just passed is no exception to the rule. These opportunities should be recognized as stimulants of progress. Important among them is the necessity of assuring greater stability and permanence of employment, not only from the standpoint of the human factors involved, but from the standpoint of maintaining greater continuity of purchasing power."

The political campaign is over. The American people have decided what kind of a government they want for the next four years. Many of the employers of the country took a vigorous part in the campaign, which is at it should be. Most of them slighted their own selfish interests and the interests of their companies while the campaign was in progress and will have a big job catching up with the procession, because the economic cycle has continued inexorably upward while they were otherwise engaged.

The defeated candidate has set a splendid example of sportsmanship and practical common sense. He has congratulated the winner and buckled down again to his job as governor of his state. Surely those who supported him so loyally can do no less.

MANY perplexing problems will face Mr. Roosevelt during his second term; the very magnitude of his victory points to the probability of factional fights among his followers. He will need the advice of business leaders if he is to find the right answers to questions on which they are best informed. As Americans they can hardly refuse that advice when he asks it, and as practical men they will not refuse it.

The best investment we can make is put thus by Mr. Sloan:

"To the extent that industry and the country at large move forward aggressively with sound principles as their guiding inspiration, will America attain progress with stability."

Open House

THE practice of holding "open house" parties in industrial plants is one that should be adopted more generally. American Rolling Mill Company and several other steel manufacturers have had highly successful affairs of this sort lately, and other companies have done the same thing occasionally.

At the Armco plants in Middletown, Ohio, and Ashland, Kentucky, the plants were open on three successive days, and every effort was made to see that the 24,000 visitors enjoyed themselves and learned something about steel making. Superintendents, foremen and employee representatives acted as guides and took responsibility for the safety of the guests. Local business and professional men, families of employees, and other residents of the towns where these people live made up the crowd of guests. At the end of the trip they were shown exhibits of the products and the various steps in the plant operations, and were given pamphlets explaining the whole process.

One of the major tasks facing industrial leaders today is the education of the general public to the importance of industry in the general scheme of things. A lot of misleading propaganda against the machine and owners of machinery has been loosed during the past few years. Here is an excellent way of combatting it.

Chips

WASHINGTON—Heartened by his tremendous vote of confidence the President starts south for a fishing trip and a good will visit to South America . . . New Congress will have heavier Democratic majorities in both branches . . . Coughlin, Townsend and Gerald Smith, snowed under by votes, have lost their nuisance value . . . Major Berry invites industry and labor to hold conferences to consider revival of NRA . . . Farm leaders demand another AAA regardless of Supreme Court interpretation . . . Enlisted reserve of 150,000 for U. S. Army proposed . . . Navy asks for more men . . . Roosevelt puts budget balancing first on his program, reorganization of departments second . . . Supreme Court will pass on three more Labor Relations Act cases . . . Social Security Board will open 56 branch offices, sends out first record forms through post offices . . . Roosevelt congratulates automobile industry on achievements and urges continued efforts to make employment continuous.

FOREIGN—Democratic countries hail result of U. S. elections as triumph for democratic ideas, Nazis believe we are turning to the individual leader principle, basis of Nazi creed . . . Rebels close in on Madrid . . . German industrialists fear raw material control program is too drastic . . . Reich wages are kept down by drafting workers under authority of General Goering who also sets number of apprentices for each plant in proportion to the number of employees . . . 8,000 Chinese quit in Japanese owned Shanghai mills . . . Mussolini decides to abolish all civil and criminal law courts and to replace them by special boards appointed by the state, lawyers will be on state salary and will be expected to ascertain and present facts.

FINANCE—Flood of dividend payments begins as companies act to avoid surplus tax penalties . . . Stock market stages vigorous surge upward as election is taken as inflation omen . . . Foreign currencies decline as European speculators rush to get in on stock boom . . . At President's request fiscal agencies start study to frame legislation aimed at restricting investment in our securities of foreign money that might be suddenly withdrawn, thus causing financial upsets.

INDUSTRY—Statements to employees of various U. S. Steel subsidiaries presage most important wage readjustment in many years, plan carefully worked out with employee representatives to give graduated increases of 5 to 25 per cent . . . Other steel companies raise wages . . . Seamen's strike ties up many vessels, costs men and managements huge sums . . . Chrysler and Standard Oil of N. J., will pay huge employee bonuses . . . End of political campaign finds labor leaders Lewis and Green still at swords' points . . . General Motors directors vote $20,000,000 bonus and wage increase . . . Garment workers demand NRA for their industry, by amendment if necesary . . . Bethlehem Steel to spend $35,000,000 for modernization and plant improvement . . . Lewis comes out against steel wage increases, evidently because they were obtained peacefully, and gains support of Roosevelt in opposition to contracts basing wage scale changes on cost of living . . . Metal trades and building trades unions demand ouster of Lewis and his C. I. O. group . . . National Association of Manufacturers ready to cooperate with Roosevelt in improving relations between industry and the government.

INDICATORS—Steel production steady at a fraction under 75 . . . Electric power index rises as drop is less than seasonal . . . *Business Week's* index rises fractionally to 75.9.

Dr. Thomas Lauds Today's Machinery

Vital Civilization Force, Head of College Tells S.A.E.

Refuting claims of technocrats that modern machines are destroying our civilization, Dr. James Shelby Thomas, president of Clarkson College of Technology, Pottsdam, N. Y., told more than 1,000 members and guests of the Society of Automotive Engineers at their annual dinner Nov. 12 in Hotel Commodore, New York, that machinery is largely responsible for a wide and sparkling culture.

"We have traveled faster and gone farther toward providing the material comforts of life in 100 years than the Old World did in 4,000 years," Dr. Thomas said.

"Again, the machine is a great educational force. Railroads, automobiles, ocean liners and airplanes are taking us everywhere, whereas our forebears, by and large, limited their goings and comings to the borders of their own counties. The telephone, telegraph and radio are telling us everything.

Machine is Fairy Godmother

"Today, the workers' relation to the whole world is what it used to be to his little, restricted community, and for the first time in human history the working man has been given some leisure to read, study and develop a hobby. The machine has in every respect been a fairy godmother to the toiler, and there is no fear that it will become a Frankenstein Monster which will eventually destroy man, its creator," he said.

Dr. Thomas pointed out that modern, labor-saving machinery not only increased employment instead of decreasing it, as many technocrats and statisticians had tried to disprove, but that today's industrial worker is far safer at his machine than was the artisan at his bench a couple of centuries ago. Sanitation, proper ventilation and lighting and, more lately, air-conditioning of factories and other places of employment have played their part in reducing the industrial workers death rate, but the heavy physical strains of an older era and longer hours have all but disappeared, he pointed out.

Although modern machines do save labor and in specific cases and do throw men out of work, other modern machines put these jobless and others to work. The invention of spinning and weaving machinery, the linotype machine, fast printing presses and automatic manufacturing machinery, he said, have developed those industries to a point where skilled labor is in acute demand and the industrial worker today is enjoying more purchasing power than ever before.

"New materials developed for some specific purpose, or perhaps to use some substance heretofore wasted as a profitable byproduct, have often been developed as a standard material in some entirely different industry. Stainless steel, developed for its corrosion-resisting qualities for manufacturing processes, is widely used as a purely ornamental material in architecture, for example, and plastics appear to have a limitless range of applications in the years to come.

Cites Paradox

"Parodoxically, the machine does throw men out of work yet increases employment; the machine does obsolete certain processes, but creates others; the machine finds ways to obsolete certain age-old materials used by mankind by making possible the use of other, newer materials. That is the glory of machinery, because in the last analysis the machine finds time for leisure for the working man, and increases his actual purchasing power both in raising his wages per hour and providing him with manufactured goods at a lower price, in many instances, than ever before."

Taking recent criticisms of the machine age, Dr. Thomas declared that the technocrats and other bewailers of this phase of today's civilization are more prone to listen to the songs of poets rather than to investigate facts. The Queen Mary and other luxurious ocean liners have no creaky wooden hulls, their decks are not littered with sailing paraphernalia, and there is little patched canvass bellying to the breezes as in the "good old days," so poets are inclined to sniff because the passengers' comfort is too comfortable; efficiency on the high seas is too efficient, and safety is too safe.

"The automobile is as beautiful as any chariot driven by any ancient charoiteer, and a car ten years old will attract comment only because of its vintage and ugliness as compared with this year's models.

"The machine is democratizing art. The man in the street wears more artistic shoes than did Henry VIII, and Henry picked his shoes as carefully as he did his women. The modern kitchen range is far more beautiful as a piece of furniture than was the dressing table of Mary, Queen of Scots, if we only forget that we fry bacon on the stove and she used her dressing table to enhance the charm which was her principle stock-in-trade," he said.

W. L. Batt, for many years active in the Society and now president of the American Society of Mechanical Engineers, presided and "Senator" Ford staged a one-man roundup of the latest in automotive design.

Wins Morehead Medal

P. W. Swain photo.

D. S. JACOBUS

Dr. David Schenck Jacobus, head of the engineering department of Babcock & Wilcox Co., will be awarded today the Morehead Medal for 1935 by the International Acetylene Association, at its 37th annual convention in St. Louis. He was cited for his outstanding leadership in formulating codes and procedures which have made fusion welding acceptable

Electro-Motive Corp. Will Spend $750,000 for Plant

General Motors Unit Finds Space Already Too Limited

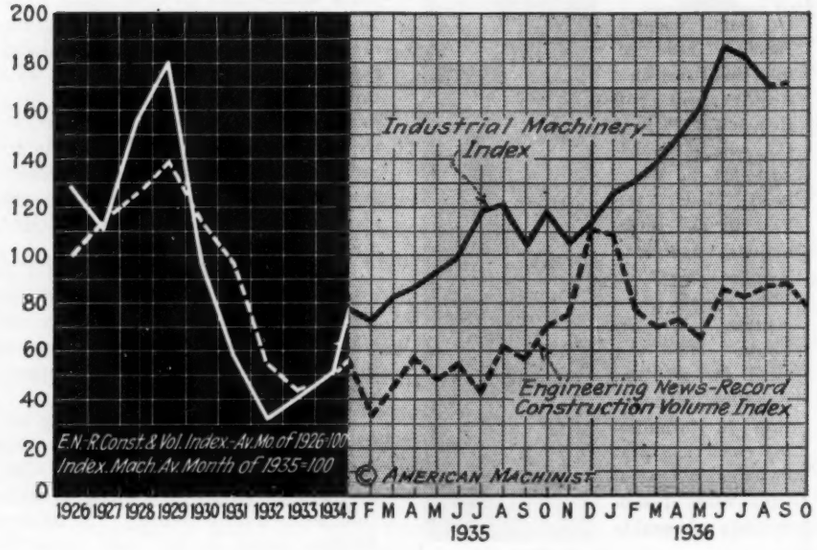
A $750,000 addition to the plant of the Electro-Motive Corp. at McCook, Ill., will be begun at once, H. L. Hamilton, president, announced Nov. 3. This General Motors subsidiary, built less than a year ago, has already outgrown its initial capacity and is in production on Diesel-electric engines for streamlined high speed trains.

Ultimately the project will represent a plant investment of $10,000,000.

The added space of 84,000 sq. ft. completes the original plans for this part of the plant, and will be ready for occupancy early in 1937.

Among the Diesel-electric locomotives built in the plant was the 3,000-hp. unit that recently established a new world's record for long distance passenger train haul when it took the Burlington Railroad's Denver Zephyr from Chicago to Denver. Many other notable Diesel-electrics under construction at the plant.

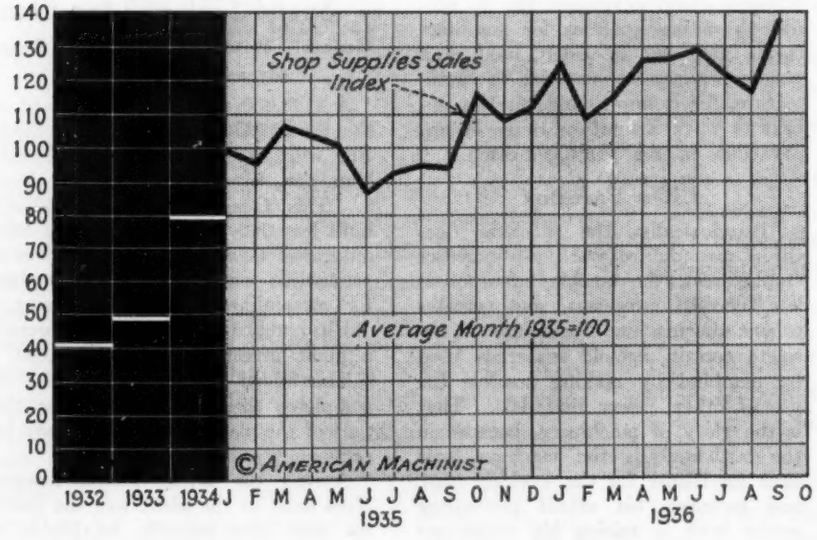
Both *American Machinist* Indexes Rise



Orders for Industrial Machinery

The September preliminary figures for the industrial machinery orders index rose about a point as compared with the final figure for August. There is every reason to expect that the increase will be somewhat more when the missing factors are included

For comparative purposes the construction volume index of *Engineering News-Record* has been plotted against the industrial machinery sales curve this month. It will be noted that this curve reached a peak in December and January, dropped to low point in May and recovered half of the losses in September. The October figure is off seasonally



Sales of Shop Supplies

Increases in all of the four shop supply indexes merged in the general indexes raised the figure for September sharply above the August figure. Indications are that the rise will continue

Both of the *American Machinist* indexes show a rise for September. The shop supply sales index jumps sharply from 116 for August to 137.8. The preliminary figure for the machinery sales index is only slightly above the final August figure but the two factors that are still missing are likely to increase it somewhat. It stands at 172.

Every one of the four factors in the shop supply sales index showed a decided improvement in September as compared with August. In one case the improvement was as much as 30 per cent.

Of the five factors included in the preliminary figure for the machinery sales index three advanced and two declined as compared with August. The machine tool sales index dropped from 149 to 138 and the index of industrial air conditioning equipment from 250 to 235. On the other hand foundry equipment improved from 142 to 157, woodworking from 170 to 188 and industrial stokers from 225 to 259. Figures for pumps and electric motors did not arrive in time to be included in the September index.

British Predict Boom Levels Will Continue

Industries Federation Finds Upturn Is Constructive

The trade forecast of the Federation of British Industries for the fourth quarter predicts a continuation of the present boom.

British export trade already is enjoying a new wave of expansion, although it is possible this may be disturbed temporarily by the recent devaluation of the gold currencies. Unemployment has fallen to a level which threatens some labor scarcity.

Wholesale prices are rising under conditions favorable to a continuance of the present constructive movement and there is nothing to indicate an imminent setback.

The federation is somewhat sceptical as to results likely to be derived from devaluation, fearing, especially in the case of France, that the gesture toward freer trade may only be perfunctory and dictated by expediency, and that internal problems sooner or later will lead to a renewed movement for national self-sufficiency. Reconstruction of the former multi-lateral system of international trade is regarded as no longer possible.

Motors AND OTHER MATTERS

Ford "60" is big Auto show news ... Chevrolet and Plymouth appear confident, but may offer smaller engines in 1938 ... Willys-Overland happy about new line - - - Machinery prospects bright for next year

DETROIT—The big news of the new automobile season is the introduction of the economy Ford, powered by a small V-eight motor. Known as the "60," this car is capable of traveling at a top speed of 70 miles per hour and of cruising comfortably at 50. In outward appearance it looks exactly like the "85" Ford, which has the regular-sized V-eight engine and is styled after the fashion of the Lincoln-Zephyr. It weighs 400 lb. less than the "85" with half of that amount accounted for by the lighter motor. The frame also is lighter.

It is a little early to predict what the influence of the new "60" will be on the low-price market. Even Ford doesn't know and is feeling its way cautiously. For November and December one-third of Ford's assemblies will be of the "60" and two-thirds of the "85." Beyond Dec. 31 no schedule has been set up.

See "Economy" Market

The Ford people think that the "60" is going to be a "natural" for the economy-minded buyer. Fleet owners, taxicab companies, farmers and people in the lower income brackets should offer a lucrative market. In Canada, Ford executives would not be surprised if 60 per cent of the sales were of the "60." If retail demand should greatly exceed one-third of Ford's productive capacity, large purchases of machine tools at Dearborn will be in order. Ford is tooled up at Rouge for not more than 1,500 to 1,600 of the "60's" per day.

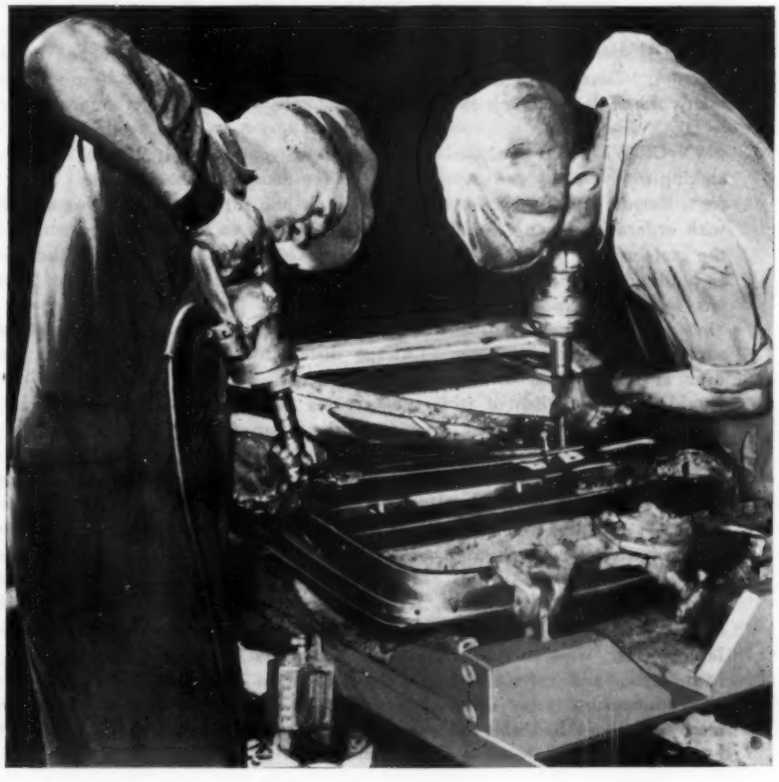
In pricing the new car, Ford has been mindful of not upsetting the used car market for his dealers. Whereas most observers felt that a price of $450 would be put on the car, actually the base price is $30 higher than that figure. Ford officials are of the opinion that if prices dipped down farther, the used car buyer would have been tempted into becoming a new car purchaser, especially with the $25-a-month plan available for financing. Even at the announced prices, some of Ford's competitors think that the "60" may have a depressing effect on trade-in values and in turn on used car prices.

Chevrolet and Plymouth evidently intend to adhere to a watchful waiting policy so far as the Ford "60" is concerned. Chevrolet's Master car, formerly the Standard, is $40 higher than the "60" and no attempt will be made at this time to lower prices. As a competitive weapon Chevrolet also has an economy car which has never been advertised but has been quietly sold to fleet buyers who insist first of all on economy. It is doubtful, however, whether this particular line will be utilized much by Chevrolet in its selling during '37.

Chevrolet appears unconcerned about the competitive situation, is willing to rely on its product and its superb selling organization to hold its position and, in fact, isn't even advertising prices because it believes that most people have enough money that $10 or $15 difference in price doesn't mean much. Plymouth is much more on the spot than Chevrolet, since it has only a de luxe line of cars with the four-door sedan priced $115 higher than the Ford "60." On the other hand, Plymouth has repeatedly demonstrated its ability to sell a car bearing a price tag higher than competitive makes.

It can be said with authority, however, that if the Ford "60" goes over big, Chevrolet and Chrysler will rush developments of small-engined cars for 1938. Just what dent the "60" will make in the market should be known within 90 days. If all three of the big fellows invade the economy field, machine tool builders will be flooded with orders early in 1937. Incidentally both of the new Ford cars

Installing lock and window regulator mechanism in door of "unisteel" turret top Fisher bodies



have cable-controlled brakes similar to those on the Lincoln-Zephyr. Heretofore much criticism was directed at Ford's brakes, especially with all competitors adopting hydraulic brakes.

Willys-Overland is happy over the prices placed on the Ford "60." since the four-cylinder Willys is still $85 to $105 under Ford. The newly-designed Willys was one of the main attractions of the New York Show. The car is infinitely better in appearance than previous models. The company is set up at Toledo to build automobiles cheaper than any other company. It makes only one chassis and two models. It claims to manufacture more cars in the same space than other car companies. It can break even with production of 40,000 cars, expects to turn out 70,000 the coming year.

Packard has met with such success with its new six that it is increasing its productive capacity to 45 to 50 units an hour. It has spent about $750,000 for new machine tools. The cylinder block line already was equipped for the required output, but machinery had to be bought for connecting rod, piston and other machining lines and for gear hobbing.

Ford's biggest capital outlay the coming year will go into erection of a tire plant at Rouge. It is understood that a composition material, including ingredients of the soy bean, will be used in conjunction with rubber. The tire plant is being built to protect Ford against a troublesome labor situation at Akron and not because Ford thinks it can make tires cheaper than tire manufacturers. The fact is that the cost to Ford probably will be higher. It will take 10 months to complete the plant, which won't be able to produce tires in large quantities until the 1938 season starts. Ford is preparing to construct another plant as an addition to its present group of small factories in southern Michigan. It will be located at Milford, home of the General Motors proving grounds, and probably will be devoted to production of valve seat inserts. Whether production of these small plants is as economical as concentration of all work in a huge plant like the Rouge works is debatable.

On car parts, the cost may be a trifle more because of greater transportation costs to points of assembly, but on non-productive parts the cost is believed about the same. From a social standpoint, of course, the advantage is with the small plant.

Machine tool buying the coming year should be as good at Detroit as during 1936 and possibly better. Machine builders should keep their eyes on Chrysler, which is due for heavy expenditures in the next six months. No outstanding programs, however, are expected to break for the next 30 to 60 days.

Automotive assemblies have risen to about 100,000 units a week and should stay near that level all winter. After a slow start, Ford expects to be making 5,000 cars a day shortly. Chevrolet has got production up to 6,000 units a day and has 132,000 unfilled orders. Buick, with a huge bank of orders, is planning 28,000 cars for December.

Car makers wish to avoid a repetition of the recession in operations last February and the coming winter intend to hold schedules up through January and February for the purpose of stocking dealers adequately before spring rush begins.

Industrial Review

• A STRONG upturn in orders for machine tools which began in October is continuing into November, according to reports from a dozen leading industrial centers. Evidently industrialists found time from their political activities to give considerable attention to business if we may judge from the increasing delay in deliveries.

• IN THE EASTERN territory served by Boston, New York and Philadelphia, distributors report little change in the satisfactory amount of business that is coming in. Delayed deliveries are having their effect in stimulating the placing of orders. Inquiries are excellent. Pittsburgh distributors report a general feeling that business will continue good and that it was little affected by the election. There is a distinct improvement in the volume of inquiries and many old deals are being closed.

• IN CLEVELAND the machinery people are operating at a high level and making some money and expect to do so for many months to come. Reports from Detroit are to the effect that small tools and supplies are moving steadily with orders for heavier equipment likely to break as production schedules in the automobile plants are stepped up. November business in Cincinnati is holding up well although long deliveries are a disturbing factor. There has been an improvement since the election. The Indianapolis report is "business as usual". In St. Louis machinery sales are rather quiet but supplies are moving rapidly. Chicago distributors have no complaint whatever at the volume of business being taken. There is considerable labor trouble but not much of it is very serious as yet. Milwaukee reports little change in the volume of business or in the labor situation.

• DESPITE the belief that Federal intervention in Pacific Coast maritime labor troubles would follow elections, conciliatory efforts have so far failed and coast shipping remains at a standstill. Shipyards in San Francisco Bay area are closed with a strike which began early last week. 500 workers at Bethlehem and Los Angeles Shipbuilding Corporation, two principal repair centers at San Pedro harbor, walked out November 12. Southern Pacific Railroad shops at Sacramento, Calif., are working at capacity, building new locomotives. Western Pacific Railroad is expected to call for bids soon on 11 locomotives and rolling equipment estimated to cost $1,800,000. Adding to labor difficulties is the election outcome. Chambers of Commerce state that many industries had planned construction of new plants contingent upon the election and have abandoned plans indefinitely.

BODINE CO. EXPANDS

Bodine Corp., Bridgeport, Conn., manufacturers of tapping machines, has acquired the plant of Springfield Mfg. Co. The company purchased Anderson Die Machine Co. in 1933. Increased business has necessitated expansion for some time, and the company is rushed with orders, Alfred V. Bodine, president, announced.

BUYS DURA CO.

Detroit Harvester Co. has purchased Dura Co., manufacturer of automobile hardware and parts, with view of merging the companies into the Detroit-Dura Co., Harry L. Pierson, president, announced.

Watching Washington

Election bolsters New Deal aims . . . Major Berry makes overtures to industry . . . Perkins' conference discusses state NRAs . . . NLRB wins court victory . . . Budget balance may be delayed

WASHINGTON—Big surprise of the election was not the retention of President Roosevelt but the landslide that swept him into office with increased support in both houses of Congress. There is no dodging the fact that by and large the American electorate likes the New Deal and that the New Deal sees in its record-breaking popular vote a mandate to continue its methods.

To American industry all of this means something definite. There is little question that business will have to submit to increased regulation, that labor will get additional laws and encouragement to aid in its organization, and that the objectives to discourage accumulations of wealth, either private or corporate, will still be sought. Many of the means toward reaching these ends are not yet clear, but there is little chance that any of them will be abandoned.

For the immediate future, most observers feel with justice that 1936 recovery will carry over into 1937. Underlying forces for the upturn are stronger than anything than Washington is likely to do. On top of this, the wave of extra dividends to stockholders and bonuses to employees is bound to be a stimulating influence. Governmental openhandedness toward special groups—farmers, WPA workers, etc.—will continue and is likely to be transformed from an emergency expedient into a permanent part of legislation.

Labor Legislation Planned

Of prime importance to industry is the prospect of renewed labor laws on child labor, minimum wages and maximum hours. Business leaders who walked out on Major Berry last winter may cast at least an appraising eye toward his December meeting. It is not for naught that his Council for Industrial Progress has been kept warm during the past months. In calling his meeting, Major Berry made another bid for increased support of industry for his plan to have management and labor join in recommending such legislation as can be agreed upon. He pointed out that a council truly representative of management and labor will be in a better position to draft legislation for submission to Congress than so-called experts on either side.

Also worth consideration, according to Major Berry, is a proposal that there be a federal law setting standards below which citizens may not be hired by another citizen. At present, he states, there are cases where the constitutional inhibition against involuntary servitude is violated in effect. Workers have the choice of accepting what is offered in the way of wages, hours and working conditions or accepting relief in one form or another. A federal law saying that wage, earners are not to be worked more than 48 hours per week would remedy extreme cases and leave to the state the question of fixing shorter hours.

NRA Idea Revived

Attending, at Secretary Perkins' invitation, the National Conference on Labor Legislation last week in Washington, several state labor representatives referred wistfully to NRA. They regard the election count as conducive to organization of state NRAs, but the objection is that all of 48 state legislatures could not agree on the enactment of labor laws patterned on the same idea. As one state labor leader stated, "All Democrats are not like Mr. Roosevelt."

Significant were the President's words to the confreence: " . . . the country has this week given a mandate in unmistakable terms to its legislators and executives to proceed along these lines until working people throughout the nation and in every state are assured decent working conditions, including safe and healthful places of work, adequate care and support when incapacitated by reason of accidents, industrial disease, unemployment, or old age; reasonably short hours, adequate annual incomes, proper housing, elimination of child labor."

On November 9, the National Labor Relations Board won a signal victory when the District of Columbia Court of Appeals upheld its right to hold employee elections as a means of determining collective bargaining representatives. Six suits had sought to enjoin NLRB from holding hearings to determine whether elections should be held. In each case the complaining company argued that such elections would result in irreparable damage by causing friction, discord, loss of efficiency and destruction of morale among its employees.

Bolstering its position is NLRB's Bulletin No. 1 "Governmental Protection of Labor's Right to Organize." Put out by its staff of technicians on labor relations, this release forms an elaborately documented defense of the constitutionality of government interference in labor disputes. Its direct basis on the board's decision in the Crucible Steel Co. case is significant in view of the rather ineffectual attempts of John L. Lewis' Committee for Industrial Organization to enroll workers in the steel industry. C.I.O. did make an unexpected gain, however, in slipping into control of one of the units of Carnegie-Illinois' employee representation plan when other factions conflicted.

Tax Law Revision

Budget balance, another cause of business apprehension, is still up in the air. Social security expenses are now being estimated. Secretary Morgenthau and Budget Director Bell are working on plans for a balance by the spring of 1938, but some observers believe that in view of continued pressures for spending the 1939 fiscal year will be the first to balance. It is probable that no additional taxes will be needed, but this does not mean there will be no tax legislation in the next Congress. Some inequalities will have to be ironed out, and the undistributed earnings tax may be revised for companies with impaired capital. There is little chance though that changes will apply to 1936 income.

Tool Orders Recover From Small Recession

October Index at 136.5 Is Within Reach of July's High

The index of machine tool orders, compiled by the National Machine Tool Builders' Association, gained 15 points during the month, reaching 136.5 for October. This was 13.6 points under the year's high of 150.1, the July mark.

This compares with the 1929 average of 155.8, the 1928 average of 131.2 and the 1919 to 1935 average of 74.9. The index is based on the percentage of average monthly shipments during 1926.

The distribution of orders through the industry, the Association reports, is the best on record, with more than a half of the companies reporting showing bookings for October equal to or better than their respective 1926 average monthly shipments.

"In the trend of orders for machine tools is seen an improvement in business for the whole group of metal-working industries," the report says.

Machinery Export Show Gain During September

7½ % Increase for Month Is Reported by Government

Exports of industrial machinery from the United States in September were valued at $13,083,350, compared to $12,171,532 in the preceding month and $9,889,000 in the corresponding month last year, the Department of Commerce reported.

The increase, placed by the department at 7½ per cent, was not distributed evenly among all lines, but was due chiefly to heavier foreign shipments of construction and conveying machinery, mining, well and pumping equipment and power driven metal-working machinery.

Moderate declines were recorded in exports of power generating equipment, textile, sewing, shoe and other industrial machinery and in printing and bookbinding equipment, according to the department.

Overseas consignments of construction and conveying machinery increased $253,000 in value over August. An increase of more than $200,000 in the mining and well machinery group was accounted for by larger shipments of petroleum well and gas well equipment and other petroleum machinery.

Machine tools led the power-driven metal working machinery group. Gear cutting machine exports, the individual class gaining most, advanced from $77,000 in August to $344,000 in September. Vertical boring mill exports increased from $64,000 to $200,000, and tool and cutter grinders increased $123,000.

Grinding machines of other types more than tripled in export value, advancing from $54,000 to $177,000. Milling machines of all classes in September increased $98,000.

SELLS ELYRIA PLANT

Willys-Overland Motors, Inc., has sold its Elyria, Ohio, plant to Bender Body Co., Cleveland, for $100,000. Formerly the Falcon-Knight line of Willys cars was manufactured there.

Finds Level of Business Highest Since 1930

Reserve Board Finds Continued Up Trend in Recovery

Notable gains in business, accompanied by improved financial and banking conditions but marked by failure of employment to keep pace, were noted in the Federal Reserve Board's commercial and industrial review of 1936, made public Nov. 8 at Washington, D. C.

Figures for ten months of 1936 pointed to America's best business year since 1930, with 1923-25 levels exceeded in many cases.

"Industry, trade and finance in 1936 show the cumulative effects of continued recovery," the board said.

"The current level of activity is higher than at any time since 1930. Production of durable goods has shown a further substantial increase and there has been a marked expansion in residential and industrial construction.

"In consumers' goods some lines have continued to show moderate increases in output and others have been maintained at high levels previously reached," the report said.

Although unemployment was found to have declined, the board observed that it still was large.

"Longer-time reasons for this continuance of unemployment in the face of rapidly expanding output include the growth of the population and the progress of technological improvements," the board said.

METALS AND PLASTICS SHOWN

Advances in metal and plastic developments were displayed at the opening recently of the Metals and Plastics Bureau, Rockefeller Center, New York, where an exhibit, including winners of the first annual Modern Plastics Competition, was installed.

A dinner attended by 300 leading executives of the two industries opened the exhibit.

LARGE COACH ORDER PLACED

An order for 505 super-highway coaches, said to be the largest single order ever placed for motor coaches, has been received by General Motors Truck Co. from the Greyhound Lines and affiliated companies. More than $6,800,000 is involved. Production work on these coaches will start soon at Pontiac, Mich.

Index of Machine Tool Orders

Based on Volume of Shipments for 1926

Month	Index of Orders: Domestic	Foreign	Total	3 Months' Average Index	% Foreign to Total Orders
1935 — October	79.5	23.4	102.9	102.9	23
November	79.2	19.4	98.6	93.8	19
December	78.1	20.2	98.3	99.9	21
1936 — January	95.7	15.1	110.8	102.6	14
February	99.8	12.3	112.1	107.1	11
March	89.0	16.3	105.3	109.4	15
April	110.9	14.8	125.7	114.4	12
May	95.7	23.2	118.9	116.6	19
June	106.5	22.3	128.8	124.4	17
July	104.4	45.7	150.1	132.6	30
August	96.1	31.4	127.5	135.5	24
September	82.9	35.6	118.5	132.0	30
October	105.4	31.1	136.5	127.5	23

Distribution of Orders

Average Indexes of Individual Companies	Companies in Per cent of Total Number Reporting: 1935 1st Quar.	1935 2nd Quar.	1935 3rd Quar.	1935 4th Quar.	1936 1st Quar.	1936 2nd Quar.	1936 3rd Quar.	1936 Oct.
200-up	40.2	5.8	14.2	11.3	13.0	17.2%	15.8%	20.0%
100-199	12.5	15.8	22.1	24.3	24.6	32.6	28.8	31.1
60-99	16.9	22.0	17.2	21.7	22.4	19.0	22.9	28.1
20-59	39.6	31.2	31.6	27.7	26.5	21.8	21.7	12.6
Less than 20%	26.8	25.2	14.9	15.0	13.5	9.7	10.8	8.2

Celebration of Patent System Is Planned

Centennial Program Will Mark Advances of Nation

The nation's leaders in applied science, art and industry will gather in Washington, D. C., Nov. 23 for the centennial celebration of the American patent system and to review 100 years of progress in American life as it is reflected by its inventive genius and to cast an eye to the future of a fast-developing age.

No previous celebration has brought together such an assemblage of men representing the thousands of inventors who have given to the world such things as electric power, radio, the automobile, the airplane, the typewriter, the fast printing press, new textiles and plastics, agricultural machinery, and thousands of other things accepted as commonplace today but unheard of 100 years ago.

Chemists, physicists, aeronautical engineers and designers, television inventors, government officials, radio experts, biologists, metallurgists and business executives are among the group expected to gather for the day's program of scientific reports and reviews culminating in a "patented dinner".

Six inventors of fundamental apparatus in common use are among those who have accepted the invitation to serve on the national committee for the celebration and to be present for the occasion. These are:

Dr. Orville Wright, Dayton, Ohio, co-inventor with his brother, Wilbur, of the first successful heavier-than-air flying machine; Simon Lake, Milford, Conn., inventor of the submarine; Dr. Vladimir K. Zworykin, Radio Corp. of America, New York, inventor of the iconoscope, the heart of television; Dr. William D. Coolidge, General Electric Co., Schenectady, N. Y., who developed the improved types of X-ray tubes now in use; Dr. Lee DeForest, Los Angeles, Calif., president of the Radio Telephone & Telegraph Co., who made radio practical, and Dr. Leo H. Baekeland, Yonkers, N. Y.

The presidents of 18 of America's leading scientific and engineering societies are committee members.

Dr. Charles F. Kettering, president of General Motors Research Corp., and holder of numerous patents now applied in the automotive and related industries, is the chairman of the national committee of 47 members which includes many of the outstanding leaders of American industry today.

German Machine Makers Suffer

Devaluations of gold-bloc currencies have caused a contraction of export orders for high-class German machines and scientific apparatus. To meet this situation, manufacturers of such equipment are offering to the Dutch and Swiss "devaluation price rebates."

Other manufacturers are attempting to repudiate existing orders from abroad. The Foreign Exchange Board, Berlin, has prohibited such a course as well as any giving of rebates.

Manufacturing Is Largest Source of National Income

Industrial Conference Board Makes First of Study Series

Manufacturing is the largest industrial source of the national income, generally contributing 20 to 25 per cent of the total, according to a study just published by the National Industrial Conference Board. In 1935, the Board estimates receipts from manufacturing in salaries, wages, dividends, interest, and other payments at $12 billion. The study makes available for the first time estimates of income from manufacturing in each state.

Income from manufacturing was a little over $18 billion in 1929, but dropped rapidly with the advent of the depression and in 1932 and 1933 was less than $8.5 billion. From this low point it has risen steadily. Preliminary indications are that a substantial gain will be recorded for 1936.

Approximately three-fourths of the total income from manufacturing, the Conference Board points out, is received in the northeastern section of the United States. Of the total estimated income for 1935, the Middle Atlantic states received 34 per cent, the East North Central states 30 per cent, and the New England states 11.5 per cent. New York alone received $2,014 million, or 17 per cent of the total. Pennsylvania, the second largest manufacturing state, received an estimated $1,352 million, or nearly 12 per cent of the total.

Salaries and wages are by far the largest single type of income contributed by manufacturing industry and account for 80 to 85 per cent of the total. Dividends, the second largest type of payment, account for 12 to 15 per cent of the total.

U. S. Tools Continue To Gain in England

Current Increase Strengthens Trend of American Products

American machine tools have made striking progress in the British market during the current year, U. S. Trade Commissioner E. B. Lawson, London, reported.

Imports of American machine tools into the British market in the first nine months of 1936 were valued at $6,880,000 compared with $3,220,000 in the corresponding period last year, an increase of 113 per cent, his report shows.

American machine tool manufacturers are not only increasing their sales in Great Britain but also obtaining a larger relative share of the improved demand, figures covering the past five years show. During the first nine months of this year, American machine tools accounted for 58 per cent of total British imports of such items compared with 53 per cent in 1935 and 1934, 46 per cent in 1933, and 41 per cent in 1932.

Germany is the outstanding competitor of the United States in the British machine tool market. British imports from Germany in the January-September period were valued at $3,330,000 compared with $1,896,000 in the corresponding 1935 period.

Lathes continued to rank as the leading machine tool item imported into Great Britain from the United States during the current year, the report shows. Drilling, milling, and grinding machines have also been in good demand. It is estimated that in the first nine months of this year American manufacturers supplied more than 50 per cent of the British imports of lathes, 65 per cent of the milling machines and over 70 per cent of the grinding machines.

"CLIPPER" SPECIFICATIONS

Boeing Aircraft Co., Seattle, Wash., has announced specifications for the six "Clipper" planes it will build for Pan American Airways.

With a gross weight of 82,000 pounds each, these flying boats will be capable of carrying more than 60 passengers and have sleeper accommodations for 40. Wing-spread will be 152 feet, length 109 feet and overall height 28 feet. They will be capable of speeds up to 200 miles an hour.

Although the project is now in the engineering stage, delivery of the first plane will be in the Fall of 1937.

A.S.M.E. Annual Meeting Program

Papers of Wide Interest to Metal-Working Field are Included

A program including a wide range of technical papers of interest to the metal-working industry has been tentatively announced by the American Society of Mechanical Engineers for its annual meeting, November 30 to December 4, at the Society's headquarters, Engineers' Bldg., 29 West 39th Street, New York.

Papers and events of particular interest to the metal-working field follow:

MONDAY, NOVEMBER 30

9:30 a.m. Council Meeting

2:00 p.m. Business Meeting

8:00 p.m. Power Session

8:00 p.m. Management Session

Time and Motion Study—Research and Application

An Investigation in Some Hand Motions, by Ralph W. Barnes

Introduction of a Time and Motion-Study Program, by W. R. Coley

Motion Study as a Basis of Establishing Proper Employee Training and Personnel Relations, by A. Williams, Jr.

Social Aspects of Motion Study, by Allan H. Mogensen

TUESDAY, DECEMBER 1

9:30 a.m. Strength of Materials

The Creep Curve and Stability of Steels at Constant Stress and Temperature, by S. H. Weaver[1]

The Interpretation of Creep Tests for Machine Design, by C. R. Soderberg[1]

Discussion of Research Activities and Progress Report to Sponsors, by Special Research Committee on Effect of Temperature on Metals

12:30 p.m. Luncheon

Lubrication Research and Application

2:00 p.m. Safety and Hygiene in Industry

Practical Results from Safety Contests, by Harold Miner

Engineer's Part in Industrial Hygiene, by Wm. Yant

Engineering Value of Adequate Operating Instructions by Dan Royer

2:00 p.m. Railroads

The Use of Alloy Steels for Side Frame and Bolsters of Freight-Car Tests, by D. S. Barrows[1]

Report on Railroad Aerodynamics Subcommittee of Aeronautic Division (to be presented by title)

Progress Report of Railroad Mechanical Engineering.

4:30 p.m. Westinghouse Nineteenth Anniversary Commemoration

The Engineering Achievements of George Westinghouse—a discussion by his former associates

8:00 p.m. Honors Night

Towne Lecture, by Dr. James Rowland Angell, President of Yale University

WEDNESDAY, DECEMBER 2

9:30 a.m. Cutting Metals

A Study of Cutting Fluids Applied to the Turning of Monel Metal, by O. W. Boston and W. W. Gilbert

Comparative Torque and Horse-Power Requirements of Standard Four-Flute and Spiral-Flute Taps, by H. L. Daasch

Cemented Carbide Tool Maintenance and Application, by L. J. St. Clair

12:30 p.m. Luncheon

Distribution: Discussion of Product and Sales Research, by Dr. L. Chalkley and W. M. Bristol. Auspices of Management Division

2:00 p.m. Machinery and Springs

Discussions of Spring Problems to Include Rubber Springs, Helical Springs, and Spring Materials

Bearing Oil-Ring Performance, by R. Baudry and L. M. Tichvinsky

Quieting Machinery, with demonstrations by E. J. Abbott

2:00 p.m. Plant Layout Management

(*Jointly with Society for Advancement of Management*)

Economics of Manufacturing Layout in a Varied Product Plant, to Include Influence of Type of Layout, Function of Feeder Sections, Flexibility, Salvage Value, and the Function of Time Studies, by A. F. Murray

Time Studies and Their Relation with Factory Layout, by B. C. Koch

6:30 p.m.

Annual Dinner, Astor Hotel

Thurston Lecture

THURSDAY, DECEMBER 3

9:30 a.m. Management

(*Jointly with Society for Advancement of Management and Personnel Research Federation*)

Dealing with Workers Today

Modern Principles and Practice of Manufacturing Organizations in Employee-Employer Relationship, by W. G. Marshall, T. I. Phillips, J. H. Priest, and R. M. Rumbel—representatives of the Westinghouse Electric Mfg. Co.

Corrosion-Resistant Metals

9:30 a.m. Symposium—I

Introduction to Corrosion Resistant Metals, by F. H. Speller

Aluminum and Its Alloys, by E. H. Dix, Jr., and R. B. Mears

Construction and Use of Lead Equipment, by G. O. Hiers

12:30 p.m. Luncheon

Maintenance: Discussion of Organization and Management of Maintenance, J. A. Jacobs, Chairman

Discussers: W. C. Zinck, J. I. Thompson, A. Vaksdal, W. O. Larson, A. E. Windle

12:30 p.m. Luncheon

Engineering Education—Topics:

Engineering Education—A Study of Principles Vs. a Curriculum in Memorizing Facts and Theories, by W. H. Carrier

Applying the Methods of Science and Engineering to Engineering Education, by N. W. Funk

Encouraging Research in Engineering Education, by H. O. Croft

2:00 p.m. Corrosion-Resisting Metal Symposium—II

Zinc in the Chemical Industries, by E. A. Anderson

Cast Iron, by Dr. H. L. Maxwell

Copper and Copper-base Alloys, by R. A. Wilkins

2:00 p.m. Management

Training People to be Skilled Workers

Symposium sponsored by Management Division, Committee on Education and Training, Society for Advancement of Management and Personnel Research Federation

F. E. Searle, Supt. Ford Motor Car Co.'s schools will discuss the selection of apprentices and their training to operate machines

Chas. G. Simpson, Philadelphia Gas Works, will discuss adult education

8:00 p.m. Corrosion-Resisting Metal Symposium—III

Corrosion-Resistant Steel, by J. H. Critchett Nickel and Nickel-Base Alloys, by F. L. LaQue

FRIDAY, DECEMBER 4

Aviation Meeting

(*Sponsored jointly by Institute of Aeronautical Sciences, Society of Automotive Engineers, and the A.S.M.E.*)

1:00 p.m.

Films will be shown of Aeronautic Research Laboratories

2:00 p.m.

Representatives of European countries to discuss aviation progress

3:00 p.m.

Aviation Five Years Hence

Round Table Discussion by leaders in the field

6:30 p.m. Dinner Biltmore Hotel

Presentation of Guggenheim Aeronautic Medal to George W. Lewis, Director, Research, National Advisory Committee Aeronautics

Finds Russian Motor Outlook Is Promising

Stanley Shaw Reports Best Tools Available Used in U.S.S.R.

Soviet Russia's automobile and truck production capacity is to be doubled during the coming year or two, according to Stanley Shaw, Michigan Tool Co., who has just returned to the United States after six months in Europe, the last three months of which were spent in a survey of industries in Russia.

This increase will provide a daily production capacity of 500 passenger cars and 1,000 1½ ton trucks at the Gorky plant. According to Mr. Shaw this plant now employs some 23,000 men and women and is remarkably efficient in its operation, and compares favorably with many plants in the United States. This is attributed to the outside viewpoints available in the management and organization and the extensive educational program for the men in the shop. Mr. Shaw estimates that approximately 15,000 of the present employees are being schooled as specialists in tool design and manufacture, die making, metallurgy, drafting, and factory management, etc. Instruction is carried on at the expense of the government and wages are paid during school hours.

He attributes the growth in efficiency partly to the abandonment in Russia of the hourly wage in favor of the "merit" system of compensation, an interesting paradox in view of the fact that the merit system is generally opposed by most labor elements throughout the world, in favor of an hourly rate.

Furthermore, he found, Russia uses only the finest machines available.

Implement Prospects Good, Convention Told

1937 Outlook Bright, and Current Year Business Satisfactory

Farm implement and equipment manufacturers expect broader markets in 1937, it was disclosed at forty-third annual convention of the Farm Equipment Institute, Oct. 7 to 8, Chicago. The current year has been a satisfactory one for volume of business, despite the drought, W. C. MacFarlane, president of the institute and president, Minneapolis-Moline Power Implement Co., reported.

Complete dependence of the industry upon agricultural prosperity was stressed by Harry G. Davis, research director of the institute.

PERSONALS

C. M. ALLEN, staff supervisor of safety and training, American Rolling Mill Co., Middletown, Ohio, has been elected to the executive committee of National Safety Council. He is chairman of the Council's metals section.

T. N. ANDERSON, general manager of manufacture, Amercian Can Co., New York, has been elected r vice-president and comptroller. C. G. PREIS, formerly chief engineer, has been elected vice-president in charge of engineering.

LARRY S. ANDRICH is now in charge of engineering and sales of Snyder Tool & Engineering Co., manufacturer of special machinery, fixtures, tools, dies, drill units and multiple heads.

W. R. CHAPIN, research director, E. C. Atkins & Co., saw manufacturer, was awarded the Sauveur Award by the Amercian Society of Metals at the recent metal Congress in Cleveland. The award was presented for "his fundamental work in connection with two-stage quenching of steel...."

D. R. DONALDSON has been appointed factory manager of Covered Wagon Co., Mt. Clemens, Mich., tourist trailer manufacturer. The company announced a sales quota of 20,000 units for 1937, four times its output for this year. Complete units are priced from $545 to $1,260.

WARREN ROBERT ELSEY has been appointed mechanical engineer of the Pennsylvania Railroad with headquarters at Altoona, Pa. Since 1930 he has been superintendent of floating equipment of the railroad at New York.

T. C. FEDDERS, vice-president and general manager, Fedders Mfg. Co., Buffalo aircraft and automotive radiators and ventilating equipment, has been appointed chairman of the Buffalo airport advisory committee.

J. M. FERNALD, general manager of Baker Ice Machine Co., Inc., Omaha, Neb., has been elected president of the Refrigerating Machinery Association. WILLIAM B. HENDERSON is executive vice-president.

E. F. HEARD has been appointed general superintendent of the Newport News Shipbuilding & Dry Dock Co., Newport News, Va. He was formerly superintendent of construction, and joined the company in 1908.

HAROLD HEATH, general manager, Humber, Ltd., and the Hillman Motor Car Co., Coventry, England, is visiting in the United States.

COL. H. G. LETSON, M.C., V.D., Ph.D., has resigned as associate professor of mechanical engineering, University of British Columbia, and will take an active part in the management of Letson & Burpee, Ltd., Vancouver machinery firm.

PAUL S. LANE, chief metallurgist, American Hammered Piston Ring division, Koppers Co., has been advanced to metallurgical research engineer.

THOMAS J. LITLE, JR., has opened a new devices laboratories at 733 Seyburn Ave., Detroit. A consulting engineer, he was formerly president of the Society of Automotive Engineers.

DR. CONRAD MATSCHOSS, director, Verein deutscher Ingenieur, and DR. ADOLPH NAGEL, professor, Dresden Technical High School, were honored Oct. 7 at a luncheon given by a group of American Society of Mechanical Engineers officers and members in New York. DR. D. S. JACOBUS, past-president, A.S.M.E., presided.

C. B. PALEN has been named superintendent of machinery installation by the Newport News Shipbuilding & Dry Dock Co., Newport News, Va. He has served as assistant superintendent of machinery since 1927.

HAROLD BYRON SMITH has been elected president of Illinois Tool Works, Chicago, succeeding the late HAROLD C. SMITH, his father. CALMER L. JOHNSON, secretary, has been elected treasurer. Directors are FRANK W. ENGLAND, CARL G. OLSON, HAROLD BYRON SMITH, SOLOMON A. SMITH and WALTER BYRON SMITH.

THEODORE F. SMITH has been elected vice-president of Oliver Iron & Steel Corp., Pittsburgh tool, vehicle fittings and hardware manufacturer.

WALTER P. SOUTHARD has joined the engineering department of Trundle Engineering Co., Cleveland, as a manufacturing executive.

W. R. SPILLER has been appointed chief engineer of White Motor Co., Cleveland truck manufacturer, succeeding F. E. ALBORN, resigned.

Honored by A.S.M.E.

REAR-ADMIRAL HUTCHISON I. CONE, U. S. Navy, Retired; ALEX DOW, past-president, A.S.M.E. and president, Detroit Edison Co., and GEORGE A. ORROK, consulting engineer, New York, have been elected honorary members of the American Society of Mechanical Engineers.

N. W. STORER, consulting railway engineer of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has retired. He is internationally known for his work in major railroad electrification programs.

DELMAR G. ROOS, who resigned because of ill health as vice-president in charge of engineering, Studebaker Corp., South Bend, Ind., is now technical advisor to the corporation, PAUL G. HOFFMAN, president, announced. He plans to spend considerable time in European automotive centers. He has served as president of the Society of Automotive Engineers.

WILLIAM H. WILLIAMS and DANIEL C. BALLOU are principals in a new motor vehicle body building company, Amesbury Coach Co., Amesbury, Mass. The company has leased the former Bridge & Smart company property for manufacturing.

DAVID S. YOUNGHOLM has been elected vice-president of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. In 1930 he was appointed general superintendent of the Westinghouse Lamp Co., Bloomfield, N. J.

WILLIAM C. HEATH, president, A. O. Smith Corp., Milwaukee, has been elected a trustee of Beloit College, Beloit, Wis.

ALDUS C. HIGGINS, president and general manager, Norton Co., Worcester, Mass., has returned from a business trip in Europe.

F. R. HOSACK, master mechanic, Missouri Pacific Lines, Kingsville, Texas, has been appointed acting mechanical superintendent of the railroad, and will transfer his headquarters to St. Louis, O. A. GARBER, chief mechanical officer, announced.

WALTER P. JACOB was elected president of the General Bronze Corp., New York. He succeeds Erwin H. Geiger, and has been first vice-president of the corporation.

GEORGE L. KNIGHT, vice-president in charge of mechanical operations, Brooklyn Edison Co., has been re-elected president of the United Engineering Trustees, Inc., representing the four major engineering societies with headquarters at 29 West 39th St., New York. OTIS E. HOVEY, consulting engineer, New York, and D. ROBERT YARNALL, chief engineer of Yarnall-Waring Co., Philadelphia, were named vice-presidents. JOHN H. R. ARMS continues as secretary and ALBERT ROBERTS, secretary, Minerals Separation North America Corp., was reelected treasurer.

JOHN DEERE EXPANDS

John Deere Plow Co., Inc., Syracuse, N. Y., announced plans for expansion program, purchasing buildings there formerly used by the Syracuse Chilled Plow Co., containing 125,000 square feet of space. The company's plans include remodeling to provide larger quarters for the Syracuse plant, according to William M. Choguill, vice-president and general manager.

OBITUARIES

JOHN E. BURKE, 51, superintendent of the Ternstedt division, General Motors Corp., Detroit, died Oct. 25, in Ann Arbor, Mich.

ALBERT R. CRABB, 45, president and treasurer of William Crabb & Co., Newark, N. J., fabric machinery manufacturers, died Oct. 20.

HARRY FLINT HUFF, 46, manager of the extruded metals and press die department, American Brass Co., Kenosha, Wis., died Oct. 21.

HENRY R. JOY, 71, former president of Packard Motor Car Co., Detroit, and a widely-known industrialist, died Nov. 5. He transferred large land holdings to the government at no profit, helping to establish Selfridge Field, one of the Army's chief air bases.

AUGUST L. KAEMS, 73, vice-president, Jambor Tool & Stamping Co., Milwaukee, died Oct. 23 while on a business trip in Iowa.

ROY C. MANSON, 54, president, Tufting Machine Supply Co., Detroit, died Oct. 26.

JAMES B. PATTERSON, 45, vice-president, Hopp-Patterson Co., Chicago, died Oct. 15. He was for many years connected with P. H. & F. M. Roots Co., and joined J. H. Hopp in forming the machinery distributorship.

FRED N. RAYMOND, 57, president, Hillside Tool & Die Co., Hillside, N. J., died Nov. 2. He served in the Navy during the Spanish-American War, Philippine uprising and the boxer rebellion in China and won the Distinguished Service Cross.

GROVER H. SCHATZ, 48, vice-president, Federal Bearings Co. and Allied Schatz Mfg. Co., Poughkeepsie, N. Y., and president of Waterbury Steel Ball Co., Waterbury, Conn., died Nov. 2.

JOHN L. SMITH, 68, superintendent of rolling mills in the M Hamilton, Ont., works of the Steel Co. of Canada, Ltd., died recently.

JAMES DONOVAN WIGGLESWORTH, 36, secretary, Hill-Clarke Machinery Co., Chicago, died Oct. 26. He was the son of ALBERT W. WIGGLESWORTH, president of the company.

MARK WORKMAN, 77, former president of Dominion Steel Corp., Montreal, died Nov. 1. He served at one time as a director of the Canadian Car & Foundry Co., Ltd.

MEETINGS

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual Meeting, Nov. 30-Dec. 4, Engineering Societies Bldg., New York. C. E. Davies, secretary, 29 West 39th St., New York.

AUTOMOBILE SHOW, NATIONAL. Nov. 11-18. Grand Central Palace, New York. Alfred Reeves, general manager, 366 Madison Ave., New York.

INTERNATIONAL ACETYLENE ASSOCIATION, 37th Annual Convention, Nov. 18-20, St. Louis.

MARINE EXHIBITION, Third Annual. Nov. 12-20, Maritime Bldg., New York. A. R. Risso, chairman, 80 Broad St., New York.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. Annual Meeting, Jan. 11-15, Book-Cadillac Hotel, Detroit, Mich.

TWELFTH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, Nov. 30-Dec. 5, Grand Central Palace, New York, Charles F. Roth, manager.

Exports of Machinery During September, 1936

	September 1936	August 1936	September 1935
Electrical machinery and apparatus	$7,969,528	$7,207,420	$6,099,926
Power generating machinery (except automotive and electric)	513,762	639,578	762,000
Construction and conveying machinery	1,276,676	1,024,222	684,891
Mining, well and pumping machinery	2,683,478	2,477,771	2,211,046
Power-driven, metal-working machinery	3,276,152	2,234,789	1,824,871
Other metal working machinery	229,773	205,425	174,197
Textile machinery	725,182	884,212	739,157

Exports of Metal-Working Machinery During August, 1936

Engine lathes	$113,794	$145,790	$45,357
Turret lathes	208,246	215,054	68,963
Other lathes	90,402	61,274	100,786
Vertical boring mills and chucking machines	199,623	63,836	56,364
Thread cutting and automatic screw machines	165,861	159,570	68,661
Knee and column type milling machines	106,849	72,882	137,895
Other milling machines	273,624	210,254	89,615
Gearcutting machines	343,739	77,510	118,849
Vertical drilling machines	15,656	6,119	15,229
Radial drilling machines	10,565	7,752	24,534
Other drilling machines	113,602	55,541	87,808
Planers and shapers	30,648	40,405	31,564
Surface grinding machines	75,321	112,050	19,925
External cylindrical grinding machines	16,590	32,895	47,790
Internal grinding machines	124,567	69,183	27,283
Tool grinding, cutter grinding, and universal grinding machines	130,369	59,161	73,272
Other metal grinding machines	176,875	55,566	85,407
Sheet and plate metal working machines	227,059	116,329	103,013
Forging machinery	11,052	68,758	99,374
Rolling mill machinery	353,802	185,828	237,448
Foundry and molding equipment	38,658	57,276	26,631
Other power-driven metal-working machinery and parts	449,250	361,756	259,130

Other Metal-Working Machinery

Pneumatic portable tools	$72,142	$55,198	$61,066
Other portable and hand and foot operated metal working machines and parts	80,197	76,448	48,454
Chucks for machine tools	18,859	12,129	16,300
Milling cutters, machine operating threading dies and taps and similar machine-operated metal cutting tools	28,666	29,390	30,223
Other metal-working machine tools	29,909	32,260	18,154

EXPORT OPPORTUNITIES

Bakery machinery, mixers, small and medium sizes. (Agency.) Curacao, Netherland West Indies. *1833.

Confectionery, ice cream and bakery manufacturing machinery and equipment. (Agency.) Instabul, Turkey. *1823.

Excavators, drag lines, road-building machinery, diesel or steam powered. (Purchase.) Timor Dilly, Portugese Timor. *1858.

Pumps and deep-well irrigation machinery and equipment. (Agency.) Cairo, Egypt. *1824.

Factory types of sewing machines for quilts and blankets. (Purchase.) Lima, Peru. *1839.

Optical inspection and testing equipment. (Agency.) London, England. *1846.

* Interested American firms and individuals may obtain the names and addresses of the foreign firms making these inquiries upon application to the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, Washington, or any district or cooperative office. Please refer to key number.

90-Deg. Bends in Non-Ferrous Sheet Materials — II

These test data are abstracted from a paper presented by G. R. Gohn, of the Western Electric Company, before the American Society for Testing Materials, July, 1936. With the tables published previously (AM—Vol. 80, page 929) there are available radii for 90-deg. bends in most of the non-ferrous sheet materials in common use. In some cases, the data apply to gages from Nos. 8 to 36, inclusive.

Radii for High Sheet Brass

Tensile strength limits are given in parentheses. Rockwell hardness values are limiting values corresponding to tensile strength limits.

Temper, B. & S. Numbers Hard	B. & S. Gage	Rockwell Hardness "B" Scale	Minimum Suitable Radius of Punch, in.		
			Bend Perpendicular to Direction of Rolling	Bend at 45 deg. to Direction of Rolling	Bend Parallel to Direction of Rolling
Half hard 2 (53,500 to 63,500 lb. per sq. in.)	36 to 11 incl.	49 to 73[1]	Sharp	Sharp	Sharp
Three quarter 3 hard (61,000 to 71,000 lb. per sq. in.)	36 to 17 incl.	67 to 77[1]	Sharp	Sharp	Sharp
	16	70 to 80	Sharp	Sharp	1/64
	15	70 to 80	Sharp	Sharp	1/64
	14	70 to 80	1/64	1/64	1/32
	12	70 to 80	1/64[2]	1/32[2]	3/32[2]
	11	70 to 80	1/64	1/32	3/32
Hard 4 (68,000 to 78,000 lb. per sq. in.)	36 to 22 incl.	75 to 83[1]	Sharp	Sharp	Sharp
	20	75 to 83	Sharp	Sharp	1/64
	18	78 to 85	Sharp	Sharp	1/32
	17	78 to 85	Sharp	1/64	1/16
	16	78 to 85	Sharp	1/64	3/32
	15	78 to 85	1/64	1/32	3/32
	14	78 to 85	1/32	1/32	3/32
	12	78 to 85	1/32	1/16	3/32
	11	78 to 85	3/32	1/8	1/4
	10	78 to 85	1/4	1/4	1/4
	9	78 to 85	1/4	1/4	1/4
Extra hard 6 (79,000 to 88,500 lb. per sq. in.)	24	83 to 87	1/64	1/32	3/32
	20	83 to 87	1/32	1/16	3/16
	19	83 to 87	3/64[2]	3/32	3/16
	18	85 to 89	3/64	1/8	3/16
	17	85 to 89	1/16	1/8[2]	3/16[2]
	16	85 to 89	1/16	1/8	3/16
	15	85 to 89	3/32	5/32	1/4
	14	85 to 89	1/8	5/32	3/8
	13	85 to 89	1/8	1/4	3/8
	11	85 to 89	1/4	3/8	1/2
Spring 8 (86,000 to 95,000 lb. per sq. in.)	31		Sharp	1/64	3/32
	30		Sharp	1/64	3/32
	26		1/64	1/16	5/32
	24	85 to 89	1/32	3/32	7/32
	22	85 to 89	1/32	5/32	>1/4
	20	85 to 89	1/32	5/32	>1/4
	18	88 to 92	3/64	7/32	>1/4
	16	88 to 92	3/32	7/32	>1/4
	14	88 to 92	1/8	1/4	>1/4
Extra spring 10 (89,500 to 98,500 lb. per sq. in.)	22	86 to 90	3/64	5/32	>1/4

[1] Rockwell hardness limits do not apply to material less than 0.0201 in. thick.

[2] Interpolated from forming data on other gages.

Radii for Red Brass Sheet

Proposed tensile strength limits are given in parentheses. Rockwell hardness values are limiting values corresponding to proposed tensile strength limits.

Temper, B. & S. Numbers Hard	B. & S. Gage	Rockwell Hardness "B" Scale	Minimum Suitable Radius of Punch, in.		
			Bend Perpendicular to Direction of Rolling	Bend at 45 deg. to Direction of Rolling	Bend Parallel to Direction of Rolling
Drawing anneal 0 (33,500 to 43,500 lb. per sq. in.)	36 to 14 incl.		Sharp	Sharp	Sharp
Half hard 2 (46,500 to 56,500 lb. per sq. in.)	36 to 26 incl.		Sharp	Sharp	Sharp
	24 to 16 incl.	43 to 65	Sharp	Sharp	1/64
	14	48 to 71	1/32	1/32	1/32
Hard 4 (60,500 to 70,500 lb. per sq. in.)	36 to 28 incl.		Sharp	Sharp	Sharp
	26		Sharp	1/64	1/64
	24	66 to 78	Sharp	1/64	1/64
	22	66 to 78	Sharp	1/64	1/32
	20	66 to 78	Sharp	1/64	1/16
	18	73 to 81	1/64	1/32	3/32
	16	73 to 81	1/64	1/32	3/32
	14	73 to 81	1/32	1/16	1/8
Extra hard 6 (70,000 to 79,000 lb. per sq. in.)	36		Sharp	Sharp	1/64
	34		Sharp	Sharp	1/64
	32		Sharp	Sharp	1/32
	30		Sharp	Sharp	1/32
	28		Sharp	1/64	1/16
	26		Sharp	1/32	3/32
	24	74 to 84	1/64	1/32	1/8
	22	74 to 84	1/64	1/16	5/32
	20	74 to 84	1/64	1/16	3/16
	18	79 to 85	1/16	3/32	7/32
	16	79 to 85	1/16	1/8	3/8
	14	79 to 85	1/16	3/16	3/8
Spring 8 (75,000 to 84,000 lb. per sq. in.)	36		Sharp	1/64	1/64
	34		Sharp	1/64	1/32
	32		Sharp	1/64	1/16
	30		Sharp	1/64	3/32
	28		Sharp	1/32	1/8
	26		1/64	1/32	3/16
	24	79 to 88	1/64	3/32	7/32
	22	79 to 88	1/32	1/8	3/8
	20	79 to 88	1/16	1/8	3/8
	18	82 to 88	1/16	3/16	1/2
	16	82 to 88	1/16	1/4	1/2
	14	82 to 88	3/32	3/8	1/2

COMPOSITION OF HIGH BRASS

Copper—64.5 to 67.5 per cent; lead—0.30 per cent maximum; iron—0.05 per cent; remainder zinc.

COMPOSITION OF RED BRASS

Copper—83.0 to 86.0 per cent; lead—0.15 per cent maximum; iron—0.05 per cent; remainder zinc.

90-Deg. Bends in Non-Ferrous Sheet Materials – II

Radii for Alloy G Brass

Tensile strength limits are given in parentheses. Rockwell hardness values are limiting values corresponding to tensile strength limits.

Temper, B. & S. Numbers Hard	B. & S. Gage	Rockwell Hardness "B" Scale	Minimum Suitable Radius of Punch, in.		
			Bend Perpendicular to Direction of Rolling	Bend at 45 deg. to Direction of Rolling	Bend Parallel to Direction of Rolling
Half hard 2 (56,500 to 66,500 lb. per sq. in.)	36 to 26 incl.		Sharp	Sharp	Sharp
	24 to 20 incl.	57 to 73	Sharp	Sharp	Sharp
	18	63 to 76	Sharp	Sharp	Sharp
	16	63 to 76	Sharp	Sharp	Sharp
	14	63 to 76	1/64		
Hard 4 (71,000 to 81,000 lb. per sq. in.)	36 to 26 incl.		Sharp	Sharp	Sharp
	24 to 20 incl.	77 to 84	1/64	1/32	3/64
	18	80 to 86	1/64	1/32 [1]	3/64
	16	80 to 86	1/32 [1]	1/32 [1]	1/8
	14	80 to 86	1/32	1/32	1/8
Extra hard 6 (85,500 to 91,500 lb. per sq. in.)	36		Sharp	Sharp	Sharp
	34		Sharp	Sharp	Sharp
	32		Sharp	Sharp	1/64
	30		Sharp	Sharp	1/32
	28		Sharp	Sharp	1/32
	26		Sharp	1/64	1/16
	24	85 to 89	1/64	3/64	1/8
	22	85 to 89	1/64	1/16	5/32
	20	85 to 89	1/32	3/32	5/32
	18	87 to 91	1/32	5/32	7/32
	16	87 to 91	3/64	3/16	>1/4
	14	87 to 91	1/16	>1/4	>1/4
Spring 8 (90,500 to 99,500 lb. per sq. in.)	36		Sharp	Sharp	1/64 [1]
	34		Sharp	Sharp	1/64
	32		Sharp	1/64	1/32
	30		Sharp	1/64	3/32
	28		Sharp	1/16	3/32
	26		Sharp	1/16 [1]	1/8
	24	88 to 92	1/32	1/8	7/32
	22	88 to 92	1/32	1/8	7/32
	20	88 to 92	3/64		
	18	90 to 94	1/16	>1/4	>1/4
	16	90 to 94	1/8	>1/4	>1/4
	14	90 to 94	1/8	>1/4	>1/4
Extra spring 10 (95,000 to 104,000 lb. per sq. in.)	36		Sharp	Sharp	1/32
	34		Sharp	Sharp	1/32
	32		Sharp [1]	3/64	1/16
	30		Sharp	1/16	3/32
	28		Sharp	1/16	
	26		Sharp	1/16	7/32
	22	90 to 94	3/64	5/32	>1/4
	20	90 to 94	3/64	3/16	>1/4
	18 to 14 incl.	92 to 96	1/8 [1]	>1/4	>1/4

[1] Interpolated from forming data on other gages.

Radii in Alloy C Phosphor Bronze

Tensile strength limits are given in parentheses. Rockwell hardness values are limiting values corresponding to tensile strength limits.

Temper, B. & S. Numbers Hard	B. & S. Gage	Rockwell Hardness "G" Scale	Minimum Suitable Radius of Punch, in.		
			Bend Perpendicular to Direction of Rolling	Bend at 45 deg. to Direction of Rolling	Bend Parallel to Direction of Rolling
Half hard 2 (69,000 to 84,000 lb. per sq. in.)	36 to 14 incl.	[2]	Sharp	Sharp	Sharp
	13	47 to 68	Sharp	Sharp	
		47 to 68	1/8	1/8	
Hard 4 (85,000 to 100,000 lb. per sq. in.)	36		Sharp	1/64	1/64
	34		Sharp		1/64
	32		Sharp		1/64
	30		Sharp		1/32
	28		Sharp		1/32
	26		Sharp		
	24	65 to 74	Sharp		1/16
	22	65 to 74	Sharp		
	18	69 to 77	1/32	1/8 [1]	
	16	69 to 77	3/32	1/8	3/16
	14	69 to 77		1/8	1/4
Extra hard 6 (97,000 to 111,500 lb. per sq in.)	36		Sharp		1/32
	34		Sharp		1/32
	32		Sharp		3/64
	30		Sharp		
	28		Sharp		
	26		Sharp		
	24	73 to 79	Sharp		1/4
	22	73 to 79	1/32		
	20	73 to 79	1/32		
	18	76 to 82	3/64	5/32	>1/4
	16	76 to 82		3/16	>1/4
	14	76 to 82	5/32	>1/4	>1/4
Spring 8 (105,000 to 118,500 lb. per sq. in.)	36		Sharp	1/64	3/64
	34		Sharp	1/32	3/32
	32		Sharp	3/64 [1]	3/32
	30		1/64	1/16	1/8
	28		1/64	3/32	5/32
	26		1/32	3/32	5/32
	25		1/32	1/8	7/32
	24	76 to 82	1/32	1/8	1/4
	22	76 to 82	1/32	5/32	3/8
	20	76 to 82	3/32	3/16	1/2
	19	76 to 82	3/32 [1]	7/32	1/2
	18	79 to 85	3/32	1/4	1/2
	17	79 to 85	1/8	3/8	1/2
	16	79 to 85		3/8	1/2
	14	79 to 85	5/32	3/8	3/4
	11	79 to 85	7/32	1/2	3/4
Extra spring 10 (109,500 to 122,000 lb. per sq. in.)	36		Sharp		1/16
	32		1/64		3/32
	28		1/64		
	26		1/64		
	24	78 to 83	1/32		
	14	81 to 86	5/32	>1/4	>1/4

[1] Interpolated from forming data on other gages.

[2] Rockwell hardness 20 to 24, B. & S. gage 40 to 64; heavier than 20, B. & S. gage 47 to 68.

COMPOSITION OF ALLOY G BRASS

Copper—70.5 to 73.5 per cent; lead—0.10 per cent maximum; iron—0.05 per cent maximum; remainder zinc.

COMPOSITION OF ALLOY C PHOSPHOR BRONZE

Copper—91 per cent; lead—0.02 per cent maximum; iron—0.10 per cent maximum; zinc—0.20 per cent maximum; tin—7.5 to 8.5 per cent; nickel—0.15 per cent maximum; 0.05 to 0.25 per cent phosphorous.

Ideas FROM PRACTICAL MEN

Swivel Fixture Dresses Both Sides of Wheel

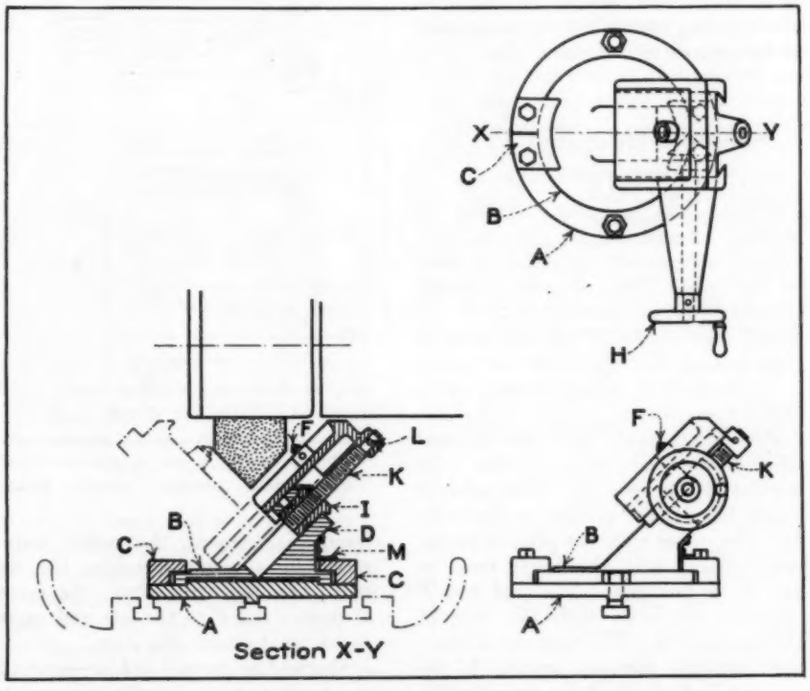
J. R. WHITTLES

For a large quantity of work in which a groove of 90-deg. included angle was to be ground on the surface grinder, we made the fixture illustrated for dressing the abrasive wheel and truing it when necessary.

On the circular plate *A* attached to the machine table is mounted the swivel plate *B*, which is held in position by the clamps *C*. The angular bracket *D*, carrying the slide on which the diamond *F* is mounted, is integral with the swivel plate. The slide is actuated by miter gears through the handwheel *H*. Miter gear *I* is internally threaded to fit the feed screw *K* and is held in permanent relation to the slide by a screw engaging an annular groove in its hub.

The feed screw is pinned to the slide at *L* and does not revolve. A miter gear (not shown) on the shaft that carries the handwheel meshes with miter gear *I* and rotates it when the handwheel is revolved. Thus, miter gear *I* acts as a revolving nut on the stationary feed screw and carries with it the slide on which the diamond is mounted. By revolving the handwheel the diamond is moved at the same angle as that of the bracket and trues one side of the wheel at the required angle.

After the angle on one side of the wheel has been trued, clamps *C* are loosened and the swivel plate with its assembly is rotated 180 deg. and is again clamped. It is then in position for truing the angle on the opposite side of the wheel. For accurate indexing, the pointer is brought into coincidence with lines scribed on the clamps. Depth of cut is controlled by the cross-slide of the machine.

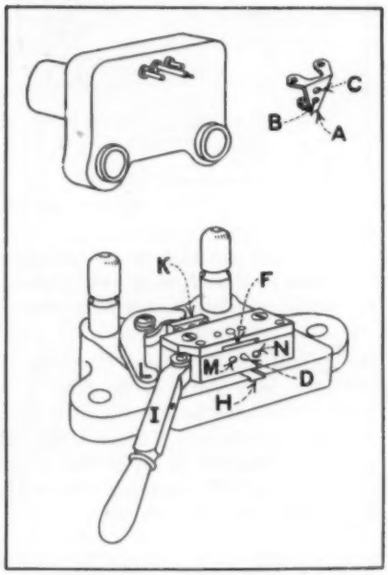


A slide on an angular bracket moves the diamond at the required angle

Accurate Piercing Tools

C. H. WILLEY
Superintendent of Manufacturing, Hoyt Electrical Instrument Works

After the part *A* has been blanked and formed, it must have three holes pierced in it, one in each of the lugs, and accurately located. The two holes *B* and *C* were pierced in the blanking operation, one being used to locate



The part is located by a pin in the front of the die-block and is held in position by a lever. It is ejected by pins in a yoke at the rear passing through holes in the die-block

the part on pin *D* in the die block. In locating the part, the two upper lugs are entered in the slot *F* in the stripper and the lower lug is entered in the slot *H* in the die-shoe. A bushing in the die-shoe serves as the die for piercing the lower lug. The lever *I* is brought against the part, holding it securely.

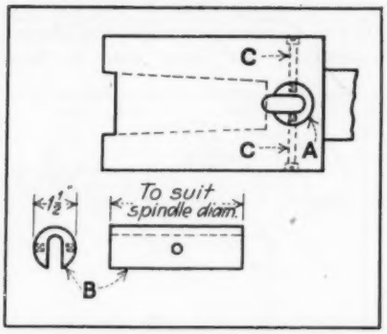
After the lugs have been pierced, the part is ejected by pins in the yoke *K* passing through the die-block. Lever *I* is swung back against one end of the cam lever L, rotating it so that the opposite end pushes yoke *K* toward the front of the die-block. Since the yoke carries the ejecter pins, they are pushed through the holes *M* and *N* and eject the part.

A Drill Press Spindle Restored to Service

P. BENTLEY
Toolroom Foreman, Canadian Pacific Railway, Ogden Shops, Calgary, Alberta, Canada

Referring to the article by H. M. James under the above title (*AM*—Vol. 80, page 560), when the tang slot in a drill press spindle becomes so worn that it will not drive the drill, we recondition it as follows:

The spindle is bored crosswise as at *A* to receive the cylindrical tool-steel piece *B*, which is slotted to match the original slot in the spindle and is hardened. Clearance holes are drilled in



A cross hole is bored in the spindle to receive a hardened insert that is slotted to match the original tang slot

the spindle for the screws *C*, which are threaded into piece *B* to hold it in place. We have found this method to be very satisfactory. Should the slot in piece *B* become so worn that it will not drive the drill, replacements can be made as often as necessary.

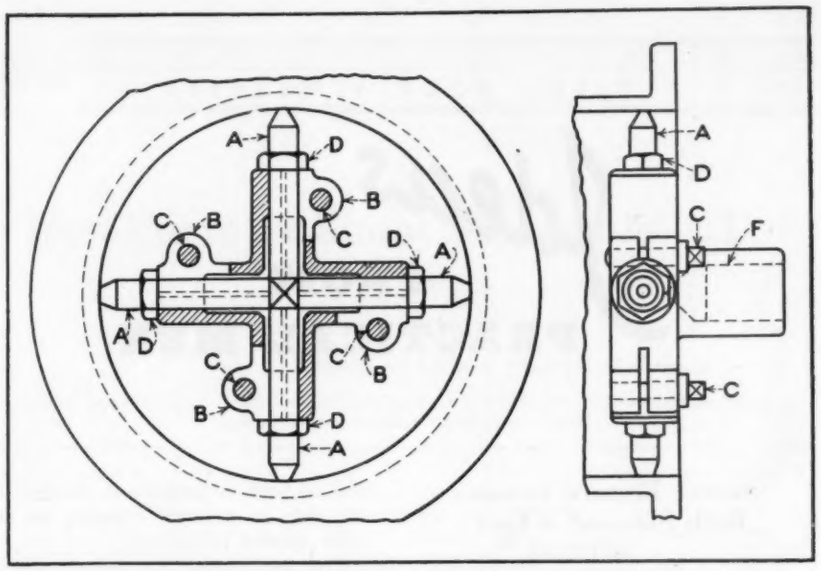
Spider for Centering Pipe

J. T. TOWLSON
Enfield, Middlesex, England

Ordinary pipe spiders are generally rather rough tools, but so long as they center and hold the pipe, little thought has been given to their refinement.

Being confronted with a large job of facing the flanges of pipe varying from 12 to 16 in. in diameter, at a competitive price, the spider illustrated was devised to save all possible time in the operation.

The spider is a steel casting and is drilled, but not tapped, to receive the four gripping screws *A*, which are splined so that keys will prevent them from turning. The lugs *B* are slit so that binding screws at *C* will hold the gripping screws tightly. The gripping screws are set out by turning the nuts *D* and are held by the binding screws, providing considerable rigidity to the device. The outer ends of the gripping screws are countersunk and take a



The spider is kept on the tailstock center of the lathe and is entered into and withdrawn from the pipe by running the tailstock spindle out or in

firmer grip in the pipe than if they were pointed.

In use, the spider is set on the tailstock center of the lathe as indicated at *F* and is pushed into the pipe by running out the tailstock spindle. The gripping screws are set out by turning the nuts *D* and are held tightly by the binding screws. In removing the device from the pipe, the binding screws are loosened and the gripping screws are withdrawn from contact with the inside of the pipe. The tailstock spindle is then backed off, carrying the spider on the receding center. It is then ready to be entered into the next pipe.

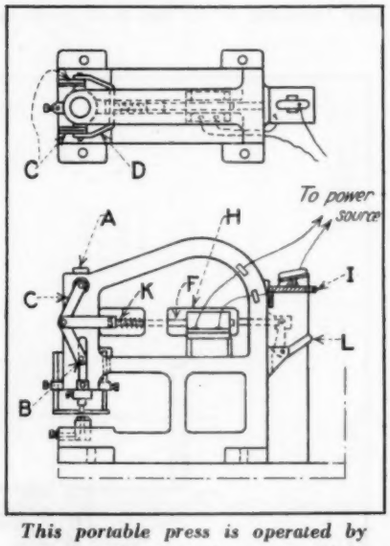
Solenoid-Operated Press

JOHN A. HONEGGER

When light piercing, riveting or staking operations are to be performed occasionally in different parts of the plant, the portable solenoid-operated press illustrated will be found convenient. While the press is rigid enough for the work for which it is intended, it is light enough to be easily transported.

Passing through the ram *A* and through vertical slots in the ram housing is the pin *B*. Two sets of toggle links *C* are pivoted to the yoke *D*. The upper ends are pivoted to the ram housing and the lower ends to pin *B* in the ram. The pull rod *F* connects the yoke with the core of the solenoid *H*. The solenoid is operated by the mercury switch *I*, the pivoted leaf of which is connected to a rod leading to a treadle on the floor.

When the treadle is depressed, the switch is closed and the current passes through the coils of the solenoid and causes the core to move to the right. This movement carries rod *F* and yoke *D* in the same direction, operating the toggle links to pull down the ram. When pressure on the



This portable press is operated by a solenoid through toggle links

treadle is released, the switch leaf is raised by a spring, breaking the current. At the same time, the spring *K* pushes rod *F* to the left and causes the links to raise the ram.

Should the current fail at any time, the press can be directly operated by

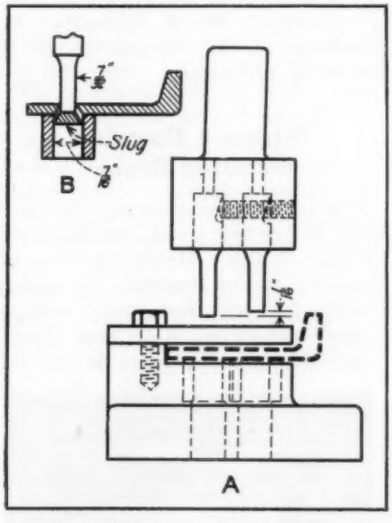
the treadle, the rod to the switch leaf being disconnected and a shorter rod used to connect the bellcrank *L* to the treadle.

Punching Screw Holes in Castings

HERBERT M. DARLING
Superintendent, Wells Tool Company

In making a large quantity of automobile heaters, it was discovered that two countersunk screw holes had not been cored in the castings for one of the parts. The castings were thin and so hard that a high-speed steel-drill would drill but a few holes without having to be ground, and the countersinking was not even tried. A few castings were annealed, but annealing meant an extra expense, and to wait for new castings meant a delay that would prevent getting out the work in season.

One of the machinists suggested punching the holes in the castings. The tools at *A* were made in a hurry and the job was started. Details of one of the punches and one of the die bushings are shown in section at *B*. It will be noted that the diameter of the punch is 7/32 in., while that of the hole in the die bushing is $\frac{7}{8}$ in. This difference in diameter caused the



A large difference in diameters of the punches and the holes in the die bushings causes the punches to break out conical slugs, leaving the holes roughly countersunk

punch to break out a conical slug of the approximate size and shape as that of the heads of the screws to be used.

The conical surface of the countersunk hole was rather rough, but did not interfere with the use of standard flat-head screws in assembling the parts. After the screws were tightened, they were found to be securely locked by the rough surfaces of the countersinks. A few castings were broken at first, but the breakage was largely overcome by making the punches of different lengths, so that one punch broke out its slug before the other one contacted the casting.

While this method may have a very limited application, yet it looks like a good stunt where countersunk holes have to be put in thin, hard castings.

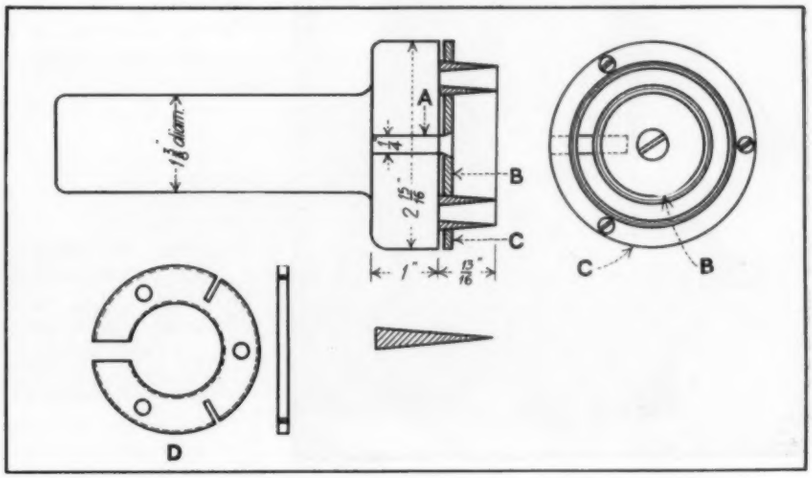
Hand Dinking Die for Soft Washers

MARTIN H. BALL

Washers can be cut from soft materials, such as leather, felt or paper, with the tool shown. The pieces cut out are removed by pushing them out with a piece of wood inserted in the slot *A*. The cutting rings are high-carbon steel, hardened, tempered, and ground on the outside only, being mounted on a taper mandrel.

Retaining plate *B* and retaining ring *C* hold the cutting rings in place, being chamfered to fit the taper of the cutting rings. Plate *B* is attached by a single screw in the center, while ring *C* is attached by three screws. In cases where the difference between the outside and inside diameters of the washer is great enough to permit the holding screws to be placed between the cutting rings, they can be held in place by the retaining ring *D*. This ring is chamfered externally and internally to fit the taper of the cutting rings. It has slits to permit a certain amount of spring and is slotted so as not to interfere with the wooden piece for removal of the washers and the slugs. The device can be used in a punch press if warranted by the quantity required.

Two cutting rings are held in place by retaining members chamfered to fit the taper of the rings



Marking Drill Lengths on Jigs

H. TOYAMA
Tool Engineer, Fusi Electric Mfg. Company, Kawasaki, Japan

It seems to be the conventional practice of nearly all toolmakers to mark only the drill diameters on the bushing plates of drill jigs, next to the bushings. I would like to propose that they also mark the lengths of the drills to be used, such as:

$\frac{1}{8}$ x 1½ in.!

The first figure is the size of the drill to be used and the last is the depth of a blind hole to be drilled, as measured from the bottom of the hole to the top of the bushing. The exclamation point (!) indicates that the hole to be drilled is a blind one and also that the figure preceding it denotes the distance that the drill should project from the chuck.

For drilling a $\frac{3}{16}$-in. through hole, the figures might be:

$\frac{3}{16}$x½ in.<

Here again, the first figure is the diameter of the drill to be used and the last is its necessary length, less the amount to be held in the chuck, to drill a through hole, as measured from the top of the bushing. The "less than" sign < denotes that the hole is a through one and also that the figure preceding it indicates the minimum distance the drill must project from the chuck.

This method of marking jig plates will prevent the mistake of drilling a through hole instead of a blind one and vice versa. It will also save time for the workman. It is an easy matter for the tool designer to find the depth of a hole from the top of the bushing when he is making the drawing of the jig.

Shop Equipment NEWS

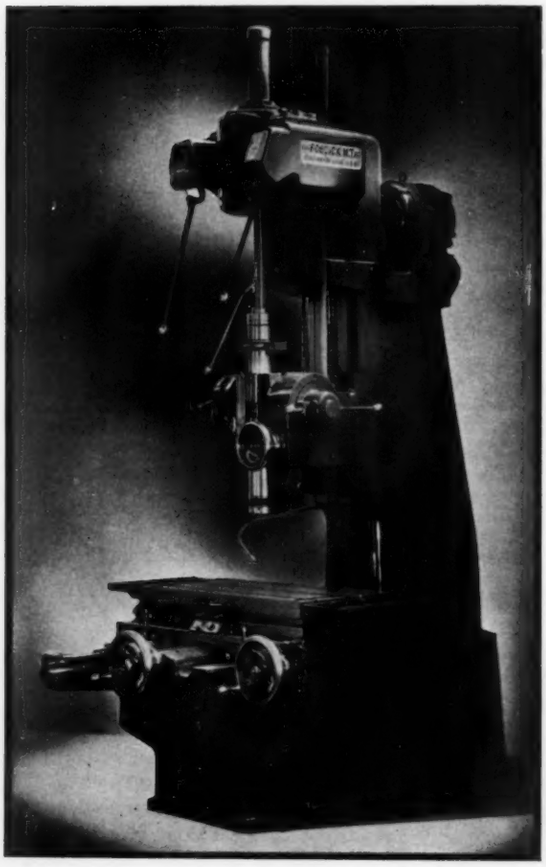
Fosdick Combination Drill and Jig Borer

The Fosdick Machine Tool Co., Cincinnati, Ohio, is marketing a combination drill and jig borer of flexible design. It can be used an an efficient drill press and features the accuracy required on a jig borer. Bearing ways of bed, slide and table are of one V and one flat. The slide is equipped with two tapered gibs. Both the slide and the table are provided with hold-down clamps and these units can be locked solidly together by means of clamps placed directly in front of the operator.

Longitudinal and crosswise table movement is controlled by large handwheels at the front of the machines. Both handwheels have three positions: one for high speed traverse, giving a table-movement of ½-in. for each revolution of the handwheel, the other gives 0.050-in. to the turn and the third is a neutral position to prevent table movement after a setting has been made. To position the table accurately a 0.0001-in. indicator is used in combination with measuring rods and a 0.0001-in. micrometer.

Drive to the spindle is obtained by means of a gear box which provides twelve spindle speeds with a range of 60 to 1,500 r.p.m., and nine feeds with a range of 0.0025 to 0.020 in. All changes are obtained by means of a single lever. Forward and reverse of the spindle are obtained by a lever-operated multiple-disk clutch. A direct-reading depth gage is provided for drilling and a measuring device is furnished for accurate spot-facing or counterboring.

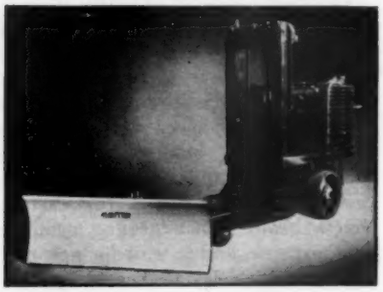
The machine has a capacity of 15 in. from spindle to face of the column and the table has a movement of 15x30 in. Distance from spindle to top of table is 24 in. Spindle nose is equipped with interchangeable collets having either No. 1, 2, 3 or 4 Morse taper.



This Fosdick machine combines the efficiency of a drill press with the accuracy of a jig borer. The table can be set to 0.0001 in.

Easton Snow Plow

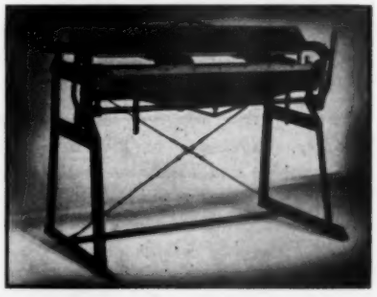
The Easton Car & Construction Co., Easton, Pa., is manufacturing a snow plow that can be easily attached to the platform of any high- or low-lift industrial truck. This Silver Blade snow plow is intended for removing snow from factory runways, yards and similar locations where trucking passages must be cleared. Snow can be pushed to either side of the runway or straight ahead by setting the blade.



The blade is mounted on a pivot and equipped with a shear pin for protection to the truck when a solid obstruction is met. Ordinary shocks are absorbed by a spring that can be preloaded to suit conditions. Adjustable shoes at the bottom provide a riding support for the blade. Standard blade is 24-in high by 54-in. wide. A clamping device provides for mounting on any standard power-lift truck platform.

Whitney Portable Bending Brake

The "Air Conditioning Special" portable bending brake, manufactured by The Whitney Metal Tool Co., at Rockford is now improved by added fingers for box and pan bending. Capacity is 49 in. of 20 gage metal. Construction is the same as for the previous model, except for changes in the arms supporting the upper jaw. These arms now have two alternative fulcrum points, so that the jaw can be raised and shifted back to accomodate the box fingers which are attached to the first edge.



Graham Variable-Speed Transmission

A self-contained, variable - speed transmission, employing only five major parts, is being introduced by Graham Transmissions, Springfield, Vt. This transmission, in a compact housing approximately motor size, see Fig. 1, furnishes any desired output speed from half motor speed down to zero and reverse. This wide range of speed is obtained through a single turn of the control wheel.

The transmission is obtainable in several combinations. The motor can be built-in, as shown, or it may be connected to the transmission by a

Fig. 1 — Graham Transmission with built-in type motor

flexible coupling, motor and unit being retained on a common bedplate. The unit also may be driven from a line shaft, or other source of power, in which case a high-speed shaft extension provided.

The unit is so designed that a geared head can be incorporated at the output end, without appreciably increasing the over-all length. The geared head provides a reduction up to 7 to 1 or a step-up as high as 1 to 4. With the latter arrangement a top speed as high as twice motor speed can be obtained. With the reduction gearing, full motor power can be developed at a top speed of 60 r.p.m. This is especially advantageous for low-speed, high-torque drives.

Power is commonly taken from a constant-speed motor, the shaft of which is connected to the carrier *A*, Fig. 2, the latter therefore rotating at motor speed. Carrier *A* supports three tapered rollers *B*, which are kept in intimate contact under pressure with a non-rotating ring *C*, and thus must turn at motor speed times the ratio of roller diameters and ring diameter at the point of contact. These rollers are inclined to the axis of the housing by an angle equal to the angle of their taper, so that their outer edge is always parallel to the central axis of the transmission. The three rollers carry planet pinions which mesh with an internal gear *D*, the latter being connected to the output shaft, thus providing a step-down ratio combined with speed variation. The variation in speed is obtained by moving ring *C* along the tapered rollers by means of rack *E*, which changes the diameter ratio of these two members.

Since the entire speed change is effected by only a few pounds pressure with a single turn of a wheel, the Graham transmission is especially adapted to remote or automatic control, by pressure or tension device, cam, pilot motor, Selsyn, or other commonly used methods.

At present this transmission is available in three standard sizes with a range of capacity up to 7½ hp. and in normal and extreme speed ranges. Both units are available with or without geared heads.

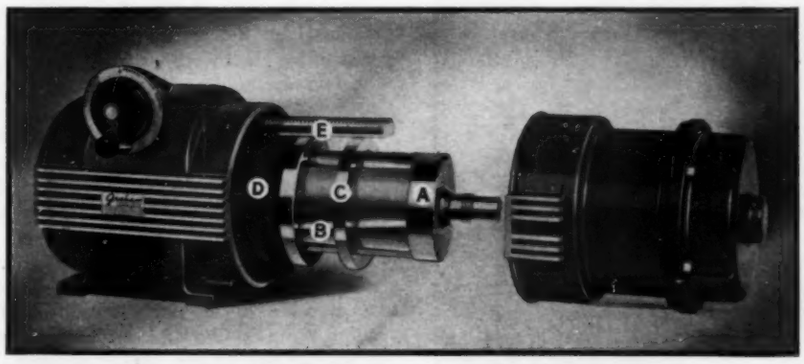
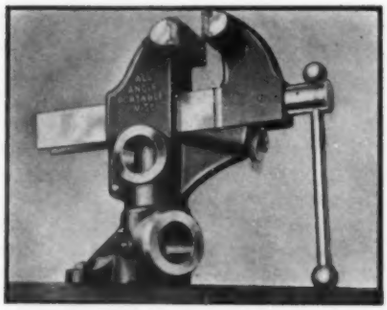


Fig. 2—Speed variation is obtained by shifting point of contact between rollers and non-rotating ring

P. & S. All-Angle Portable Bench Vise

A bench vise that permits locking of the work at any angle in any of four different planes is announced by the

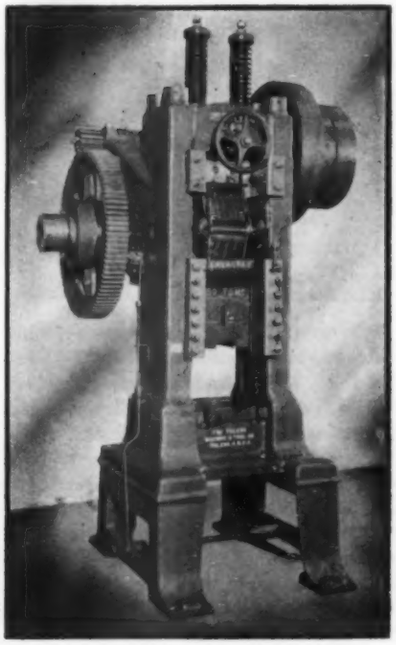


Police & Sportsman Supply Co., 349 S. Vermont Ave., Los Angeles, Calif. This vise is mounted on a tubular post which, in turn, is mounted in a base bolted to the workbench.

The post can be used in either a vertical or horizontal position, and the vise can be used straight up or sideways in either position of the post. Closing the vise jaws on the work automatically locks the tool in the desired position, or it can be locked by tightening a thumbscrew. The post is secured in either position by a pin. Two sizes are available in either a woodworker or machinist model with removable hardened steel jaws, 2½ or 3½ in wide. Interchangeable jaws can be used. The vise is made of accurately machined alloy-steel castings.

Toledo 150-Ton Coining Press

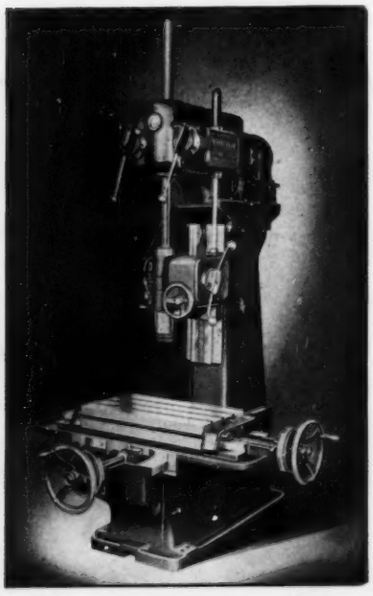
The Toledo Machine & Tool Co., 1420 Hastings St., Toledo, Ohio, has announced a 150-ton tie-rod frame-knuckle-joint press. It is adapted for the sizing or cold finishing of forgings



and other coining, extruding, swaging and cold squeezing operations. The uprights, crown and bed are of high tensile strength, pearlitic alloy castings and are held together by steel "shrunk-in" tie-rods. The clutch is of the rolling-key type. Operating speed of the geared press illustrated is regularly 43 strokes per min. Presses of this type are available in capacities from 25 to 2,500 tons.

Cleereman Toolroom Layout Machine

The Cleereman Machine Tool Co., Green Bay, Wis., has developed a toolroom layout machine for drilling and jig boring operations. This machine is exclusively distributed by Bryant Machinery & Engineering Co., 400 W. Madison St., Chicago, Ill. It will handle all tool, die, jig and fixture layout work where a tolerance of 0.001 in. in either direction is permissible. It is also valuable for experimental and short-run production work where special tooling is not warranted and closer tolerances are not necessary. Eight-inch diameter reading



dials on the table lead screws facilitate accurate readings. Scales, graduated in sixteenths, are mounted on the ways for a quick check on table movements in both directions. This machine also can be furnished with one of the following measuring arrangements.

Arrangement No. 1 substitutes precision, hardened and ground tool steel lead screws for the cut lead screws regularly furnished. These lead screws are guaranteed accurate within a tolerance of 0.001 in. in 2 ft. of length.

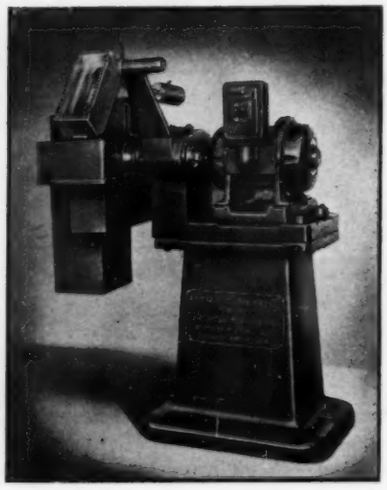
Arrangement No. 2 consists of the provision of accurate measuring instruments for the standard machine. Built-in dial indicators graduated to 0.0001 in., 1-in. inside micrometers reading to 0.0001 in. and precision end-measuring rods in 1, 2, 3, 6 and 12 in. lengths are provided for each direction of table travel.

Arrangement No. 3 includes all of the features provided in arrangements No. 1 and No. 2. The hardened and ground lead screws provide adequate accuracy for most jobs and the large dials will permit rapid positioning of the table. Precision end measuring is available for those jobs requiring tolerances closer than 0.001 in.

Campbell Abrasive Tool Crib Cutter

The Andrew C. Campbell Division of American Chain Co., Inc., Bridgeport, Conn., announces the No. 0 Tool Crib Cutter. This wet abrasive cut-off machine will cut practically all types of materials of the smaller sizes. Solid bars up to $\frac{3}{8}$-in. square or round and tubing up to $1\frac{1}{4}$-in. diameter can be handled. Hardened steel is cut without discoloration or drawing the temper.

The machine can be used either wet or dry and amount of coolant used is readily adjusted. This model handles the coolant without the use of a pump. Cutting disks up to 12-in. diameter and 1/16 to $\frac{1}{8}$-in. thick, can be used. The V-type material holder is mounted on an arm that swings from the top of the machine. This holder extends 3 in. on each side of the disk and has two adjustable stops. One stop controls the swing of the arm and the other locates the material to be cut. The swing frame is provided with a guard



which is fitted with an extra-heavy glass window, permitting observation of the cutting operation. Material is swung against the disk by hand feed.

Material holder extensions are available in 2, 4, 6 and 8-ft. lengths for use on either or both sides of the cutting disk. These holders are connected to the material holder swing arm and oscillate with it. The 1- or $1\frac{1}{2}$-hp. ball-bearing type motor operates at 1,800 r.p.m.

The machine is 46-in. high and occupies a floor space area of 30 x 31 in. Height from floor to center of material holder is $31\frac{1}{2}$ in. Net weight, without holder extensions, is 410 lb.

Noble & Westbrook No. 24A Marker

The No. 24A precision marking machine offered by Noble & Westbrook Mfg. Co., 20 Westbrook St., East Hartford, Conn., makes two different impressions at one time. It is a self-

contained unit, driven by a motor mounted on the base.

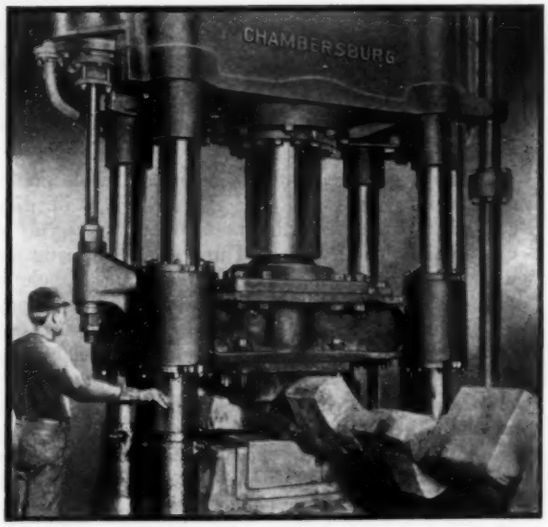
Marking is by the rolling process, the two die holders being mounted at different spots in the path of rotation. The application illustrated knurls as well as marks names and trade marks. The knurling die is of sufficient length to allow the work to pass over it twice.

Supporting pins are designed to hold the parts loosely, so that they can revolve freely, but offer sufficient support during marking so that there is no damage to the parts. Capacity is 75 parts per minute marked with a double impression.

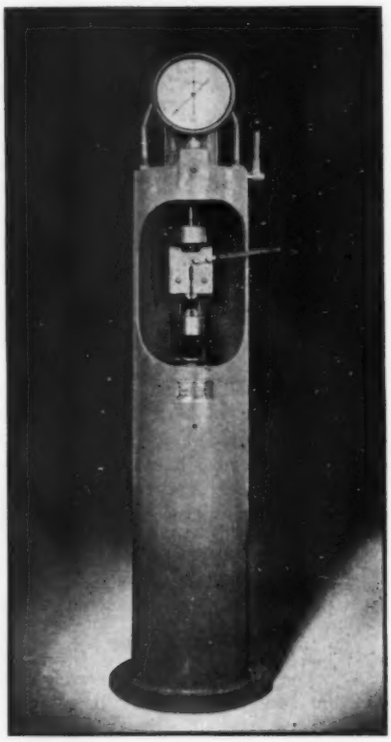
Chambersburg-United High-Speed Forging Press

Heavy forgings are economically produced to a close degree of accuracy by the high-speed steam-hydraulic forging presses recently added to the line manufactured by the Chambersburg Engineering Co., Chambersburg, Pa. These "United" presses are built in single-frame and four-column models Both models embody the same principles and application, the difference being only in capacity and physical features. Essential elements are the press, the steam intensifier and the water reservoir or prefiller tank. Close control of the forging stroke is attained by a controlling gear attached to the intensifier. The operator has complete control of the action of the machine.

The single-frame press is built in 150-ton and 500-ton sizes. It is particularly suitable for railroad and other repair shops where a variety of bending, forming and forging operations are performed. The four-column model is built as a single-cylinder press up to the 1,500-ton size, and as a duplex ram press in 2,000-ton capacity and over. These presses utilize exhausting steam for useful work at the beginning of the following lifting or pressing stroke. This results in an average reduction in steam consumption of 25 per cent. Increased speed of operation is another feature of these presses.



Four-column Chambersburg-United press forging a large multi-throw crankshaft



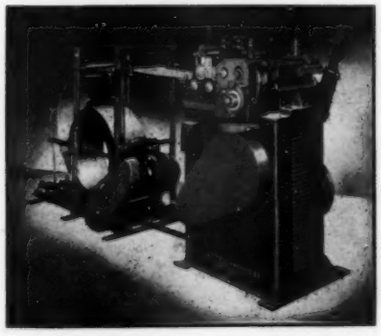
with an 18. in. diameter base for rolling it from one position to another. A hoisting hook is provided for moving the unit by crane. Over-all height is 70 in.

An 8-in. precision dial indicates the load. The hydraulic cylinder is mounted at the top of the machine and has a 4½-in. diameter ram with a 2-in. stroke. Fluid under pressure is furnished by a gear pump in the base of the machine. A ¼-hp. motor is direct-connected to the pump.

Grips are self-aligning and lever-operated. Hard, sharp grip faces made of short sections of machine cut files are easily replaced. Specimens up to 1¼ in. wide by ¼ in. thick can be gripped without using backing plates or liners.

Littell Automatic Punch-Press Feed

The F. J. Littell Machine Co., 4127 Ravenswood Ave., Chicago, Ill, is marketing a motor-driven, intermittent feeding unit for delivering coiled stock to double-action presses. This unit is so arranged that it will feed the required amount of stock into the press each time it is tripped. It is driven by its own motor and has a one-revolution clutch. It is mounted on a rigid, welded-steel base and can be moved to any press.



The feeding unit is equipped with a five- or seven-roll straightener, which is not usually power driven. A power-driven stock reel is used so that the feeding unit always feeds from a loop of material. This reel is fitted with an automatic shut-off to prevent the loop from becoming too large. Reel can be either of the cradle or automatic-centering type, depending on the weight of the coils.

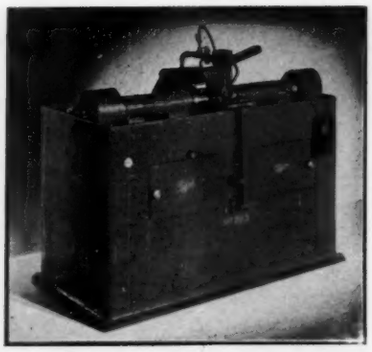
Baldwin-Southwark Spot Weld Tester

Developed for accurately testing the strength of spot welds, this 5-ton hydraulic tension testing machine, announced by the Baldwin-Southwark Corp., Philadelphia, Pa., is a convenient unit for all kinds of tensile testing. The machine weighs approximately 800 pounds and is supplied

Grant Double-End Chamfering Machine

The Grant Mfg. & Machine Co., 90 Silliman Ave., Bridgeport, Conn., has announced the No. 283 double-end automatic chamfering, facing and burring machine This unit will handle work up to 2½ in. diameter from ¾ to 6 in. long. The set-up shown is for finishing both sides of 1¼ in. nuts. Nuts are loaded in a magazine by the operator, after which all feed, clamping, machining and ejection operations are automatically performed.

The chrome-nickel steel, heat-treated spindles run in bronze bearings. Drum-type cams with removable



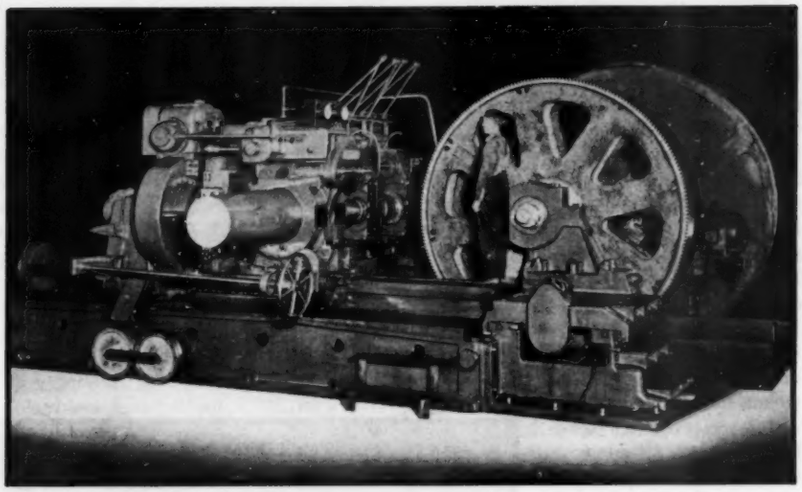
plates operate the spindles. Motor drive is through silent chain. Change gears are provided for both spindle speeds and feeds. Force-feed lubrication is provided for all bearings. Machine can be operated by a crank handle for setting the tools.

Landis Type 30 Roll Grinder

A Type 30 roll grinder weighing over 90 tons has recently been completed by the Landis Tool Co., Waynesboro, Pa. This machine has a 60-in. swing and will take 312-in. between centers. Headstock and footstock spindles are 12 in. in diameter. Grinding wheel spindle bearings are 6 in. in diameter and 14 in. long. Weight of the grinding wheelhead alone is approximately 8 tons. The machine is equipped with nine electric motors. These motors total 113¾ hp., ranging in size from ¼ to 60 hp.

Control is from an operating platform on the traveling wheel carriage. All machine movements are controlled from this point and the contact between wheel and work is always in plain view. A crowning and concaving mechanism of the adjustable crankpin type is provided. Flood lubrication with filtered oil is provided for the grinding wheelhead, the wheel carriage ways, the traversing mechanism and the work spindle.

Farrel-Sykes Gear Generator



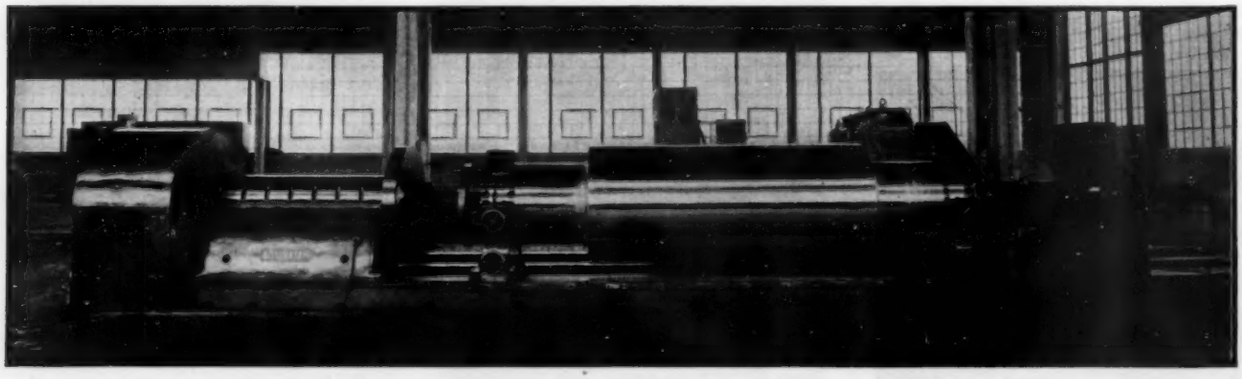
This Farrel-Sykes gear generator will handle gears weighing up to 90 tons, up to 26 ft. diameter with a 5 ft. face

Two large gear generating machines have been constructed by Farrel-Birmingham Co., Inc., Ansonia, Conn., for shipment to Russia. They are similar to six others built by this concern for use in its Buffalo plant, but are considerably larger. Each of these machines is capable of cutting practically every known type of gear that operates on parallel axes, including straight-tooth gears, single-helical gears and double-helical or herringbone gears made either with continuous teeth or with a gap between the right and left-hand helices. In addition, they will cut internal gears with either straight or helical teeth.

One of the units will cut gears up to approximately 26 ft. diameter with a maximum face width of about 5 ft. and a maximum of 6.18 in. circular pitch. The other machine has the same capacity, except that its diameter capacity is approximately 20 ft. These gear generators are also capable of cutting pinions of small diameter without additional attachments. The hole in the main spindle is more than 30 in. diameter, so that pinions made integral with shafts can be cut by passing one end of the shaft through the hole in the spindle and the other end through the 32 in. diameter hole in the outer bearing support. Total weight of the largest machine is approximately 265,000 lb. Weight of cutting tools ranges from 140 to 400 lb. each.

P & H Robot Welder

Using standard coated rods, the P & H arc welding robot, announced by the Harnischfeger Corp., Milwaukee, Wis., makes possible increased speed in production welding. This unit can be used on flat work of any length, on circular pieces and, with pantograph attachment, for any shape. It is adaptable for use on lathes, planers, rotating tables, boring mills and, with wall cranes, for welding long girders.



Rolls weighing up to 75 tons are easily handled on this Landis roll grinder

The P & H welding robot makes possible increased welding heats

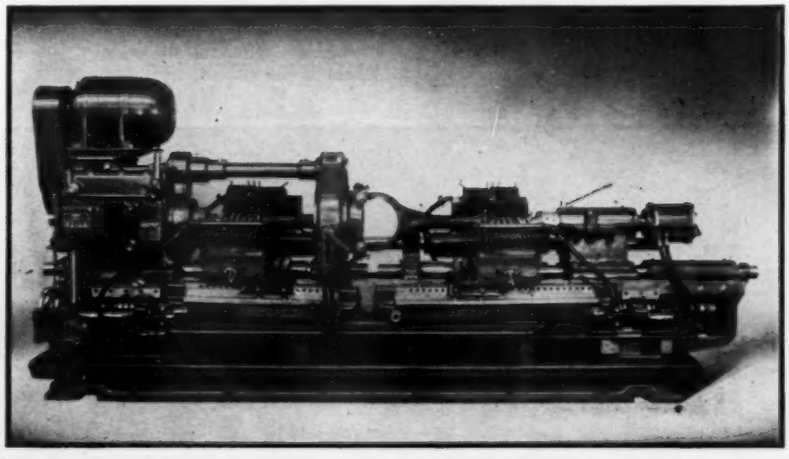
Up to 50 standard coated rods are loaded in a magazine and then fed automatically to the welding position. As one electrode is consumed, the remaining butt is ejected and a new, full-length rod is fed into place. During this feeding operation the work table stops and then starts again automatically as the new electrode makes the electric contact. The action is so rapid that no break in the welded bead is evident. Arc length is automatically regulated at a constant point during the welding operation. Though the working surface be irregular, there is no apparent variation in the penetration or appearance of the bead.

Center Drive for Fay Automatic Lathe

The Jones & Lamson Machine Co., Springfield, Vt., is building a center-drive attachment for the 20-in. J & L Fay automatic lathe. This attachment makes possible the simultaneous turning of both ends of long, heavy shafts and similar pieces. One of these attachments is shown set up for first-operation turning, facing and forming both ends of a truck rear-axle housing. A similar machine has been set up for second-operation work on the same housing. In both arrangements the housing is driven by a fixture, mounted in the center-drive attachment, which engages the banjo portion of the housing. Adjustable bearings are provided in this fixture for supporting the housing as well as driving it.

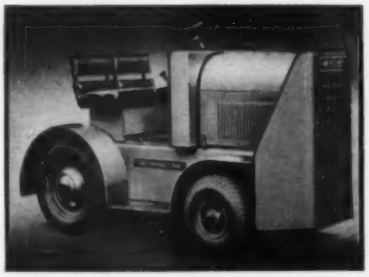
Of special interest is the chucking attachment for the second operation. During this operation the housing is held on both sides of the center-drive unit by fixtures which grip on the round portion of the housing as close to the flanges as possible. This reduces vibration during the machining operation and limits and finish are such that grinding operations have been eliminated. The clamping devices on these fixtures are adjustable so that the work is not sprung when the fixtures are locked.

The housings are machined in a similar manner in both operations. Housings are mounted between centers. The headstock center is spring loaded and adjustable, and the tailstock center is mounted in an air operated ram. Carriage tool-carrying members are mounted on separate center bars which are controlled by cams so that both carriages feed toward the center of the machine. The front former slides are also arranged to travel in opposite directions. Each carriage carries eight turning tools and two chamfering tools. Each back arm carries five facing tools and one chamfering tool. Using a spindle speed of 67 r.p.m. a floor-to-floor time of 4 min. 5 sec. per housing is obtained.



Mercury "Huskie" Industrial Tractor

The "Huskie" gasoline-powered industrial tractor is announced by the Mercury Mfg. Co., 4118 S. Halsted St., Chicago, Ill. This unit is a four-



wheel machine and is available with either solid rubber or pneumatic tires. It is powered with a 4-cylinder Ford engine and has a 4-speed truck-type transmission and clutch. It is 96 in. long, excluding coupler, and is 48 in. wide. The wheelbase is 54 in. and the turning radius is 108 in. It is capable of developing up to 3,000 lb. drawbar pull and travels at speeds up to 10 m.p.h. Weight is 3,450 lb.

Lincoln Electrode for Chrome Steels

"Chromeweld 4—6" is a coated electrode introduced by the Lincoln Electric Co., Cleveland, Ohio, for welding low-chromium steels. This electrode contains molybdenum and provides weld metal possessing the necessary high creep strength and other qualities essential for welding 4 to 6 per cent chromium steels. Such steels, welded with this electrode, can be soft annealed to physical properties similar to those of mild carbon steel and therefore rendered suitable for equipment where severe cold working is applied during fabrication. These electrodes are available in 1/8, 5/32 and 3/16 in. diameter sizes.

DeVilbiss Type MPH Hood Respirator

Designed for use in those occupations where there is fume or dust hazard beyond the protection offered by the more common type of respirator, The Type MPH hood respirator is announced by the DeVilbiss Co., Toledo, Ohio. This unit covers the head and neck fully and provides complete protection against materials harmful to eyes, ears or respiratory organs. It is recommended for use in atmospheres containing offensive chemicals, nauseating vapors, lint, paint spray, dirt or dust.

The unit consists of a light-weight headgear, air filter, air hose and a sanitary flame-proofed hood which is supported by the headgear, and fast-

ened around the neck by a draw string. The air hose is connected to an air line with a quick detachable connection. Air flows into the hood through the filter, diffuses throughout and, flowing out through the opening provided for vision, prevents outside atmosphere from approaching the eyes or entering the hood. Clear vision, without glass or other transparent material to become fogged, is provided with perfect safety.

EC&M Mill-Type D. C. Starter

The "RD" mill type starter, announced by the Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland, Ohio, provides a universal, compact and standardized unit suitable for use with a wide range of motor sizes. These starters employ mercury acceleration relays which permit a time range of ½ to 2 sec. per step. They are quickly adjustable for this time range by means of a thumb screw and lock nut.

A 3-coil, unbreakable resistor is mounted on the top of the starter cabinet and is covered by a ventilated inclosure. By changing the manner in which these resistors are connected, these starters can be used with any 230-volt d.c. motor within the range of 5 to 25 hp. They are also suitable for use with a range of horsepower sizes on 115- and 550-volt motors within the ampere rating of the contactor.

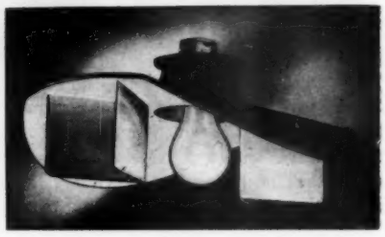
Hooper "Fire Chief" Fabric Finish

The William E. Hooper & Sons Co., Philadelphia, Pa., is introducing "Fire Chief" cotton duck finish, both as a treated fabric and as a finishing compound. Cotton duck, when treated with this compound, will not ignite, even when exposed directly to fire. In addition, the finish waterproofs the fabric, makes it mildew-resistant, and adds materially to its life.

"Fire Chief" is available as a finished fabric under any of the "Hooperwood" brands of cotton duck. It is also marketed as a separate finish known as "Hooperwood Fire Chief Compound" that can be applied, either by painting or spraying, to any type of cotton duck. This material will have many uses in industrial plants, principally for fireproofing welding- and paint-booth curtains and for machinery and merchandise covers.

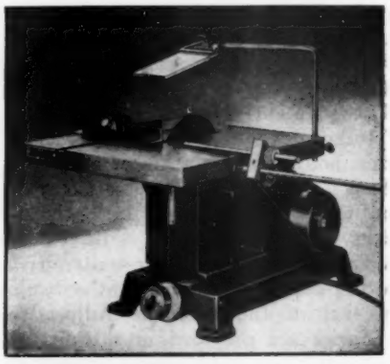
Westinghouse Bin Lighting Unit

A luminaire, designed to concentrate light on the vertical and horizontal surfaces of bins and stacks, has been announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The unit consists of a reflector and socket cover, with socket. The reflector is designed to reflect more light to the working plane and to cut off light up and down aisles between bins. Standard 60, 75 or 100-watt inside-frosted lamps can be used.

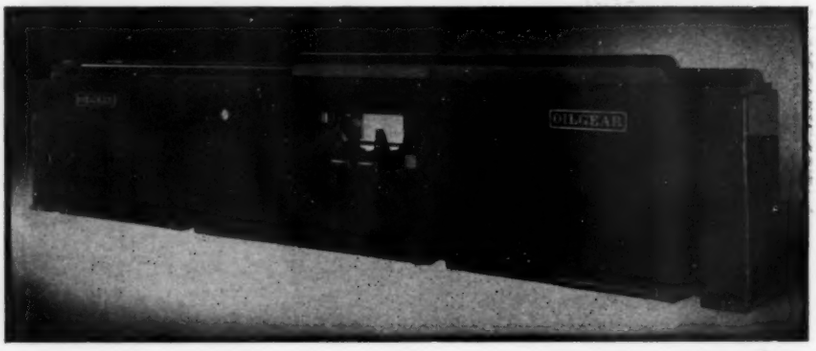


Challenge Abrasive Cut-Off Machine

A capacity for any metal up to 1 in. thick is provided in this abrasive cut-off machine, manufactured by The Challenge Machinery Co, Grand



Haven, Mich., as a self-contained unit. The 15x14-in. table is adjustable. Gages are conveniently located and are easily adjusted. Base is of cast iron. A 6x$\frac{3}{32}$x½ in. elastic cut-off wheel is furnished.



The Round Table

GOOD AS NEW?

"Have a breakdown, Al? I see you've got men at work on that old turret lathe."

"No breakdown, Ed. I'm having it overhauled.

"I thought you believed in new machines. I never expected to find you spending money to rebuild a machine as old as that."

"You're right about one thing anyhow, Ed. I do believe in new machines. But I also think there are times when it pays to rebuild the old ones."

"Is there anything special about that particular turret to make you break over your yen for new machines, Al?"

"Yes there is, Ed. It's a husky lathe but so are some of the new ones. The main thing is it is simple and just fits our work. If I could buy a new one just like it or almost like it I'd probably do it."

"What ails the new ones that you don't like 'em, Al?"

"I like them all right, but for our particular work we don't need the new gadgets they've stuck on them. This machine does our work very well, and we can overhaul it at a fraction of the cost of a new machine."

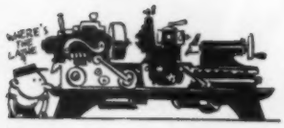
"Suppose the users of our pumps kept rebuilding them instead of buying new ones. Where would our business be?"

"That's just what they do, Ed. Sometimes it's sensible to do so. Sometimes it costs more than it's worth. It's the same way here. I'm still guessing that in this particular case we save money by rebuilding."

"Don't seem right to me, Al. Do you know anyone else who is playing this game—any real concern I mean?"

"Sure do, Ed. That's one reason I'm so certain I'm right. It's a big concern too. They spend thousands on new machine equipment every year, yet they have certain machines that they rebuild regularly."

"It must look funny to have a lot of antiquated museum pieces in a modern shop. But perhaps they like antiques."



"It's no fad or joke either, Ed. They've got cold figures to back up their decision. And I'm sure it will save us money in this case also."

"Next I know you'll be rebuilding that old planer I suppose."

"Probably not, Ed. That has seen its best days. And the new planers have it all over that one. But I'm still thinking it's a wise move to rebuild that turret lathe."

Is Ed right in thinking they should buy a new machine? Or is rebuilding the best course for certain kinds of work?

DISCUSSION

Covering Up

Whether it is good business, the necessary evil, or a bad precedent to cover up depends upon several pertinent conditions.

There are cases where the manager and the engineer are closely bound, through family connections, socially or by just plain confidence. It should be up to the representative in the territory to find out how the two men stand. In this set-up it would be prudent to absorb the repair cost as the manager may know of the condition. He would be glad to have the engineer covered up, thereby saving his own face on the balance sheet, and would reciprocate with an order.

Like giving free air at a gas station, it is often traditional to make repairs or adjustments that are not warranted.

Should the repair expense be absorbed, and should an order for several additional pumps be secured, the manager would have a perfect right to believe that there are design and constructional defects in all machinery. Since the returned pump was repaired without discussion, Al really admits such a condition existed. Pumps may be sent back at regular intervals for-

ever more. The more pumps sold, the more grief. Unless a close bond exists between customer and supplier with sufficient profit, it would be setting a bad precedent. —W. E. FISCHER.

Al and Ed are in a tough spot. If they get after the negligent engineer they may save a repair bill on the damaged pump, but unless a miracle happens and their customer goes back on his engineer, they are certain to lose his future pump business. So in my opinion they would be wise to pocket their legitimate indignation and dispatch a new pump with lubrication chart attached on the heels of a communication such as this:

Big Bend Paper Company:
Gentlemen:

We have received the 3G pump recently supplied you and as it will be a few days before we can repair the damage done, we have dispatched a new pump carefully inspected and lubricated so that you may be inconvenienced as little as possible.

Since we pride ourselves on the quality and workmanship that have made our pumps such efficient units, we have gone over the damaged pump carefully to find the cause of failure. In our opinion, lack of adequate lubrication caused the trouble. Not claiming superhuman qualities for our inspection department, and being reluctant to believe that your competent engineer was remiss in the matter of lubrication, we have decided to accept responsibility.

In line with our policy of utmost service to our customers, we are sending you a lubrication chart covering all moving parts of the 3G pump, and the recommended lubricants, which have proved satisfactory to other users of our product under conditions similar to yours. In closing, we promise, should you favor us with any future business, to cooperate with your engineer in all matters pertaining to efficient pump operation.

Yours very truly,
The Al and Ed Pump Company
—ROBERT S. ALEXANDER.

It may be smart business to cover up for the man who will decide future orders, but it is a poor sales policy that has to resort to such methods to sell products. The concern that delivers quality, durability and long, carefree service in its product need not back down and appear in an unfavorable light to the customer just because the pump failed through the engineer's neglect to oil it. The idea that so-called friendship between buyer and seller is essential to doing business is one of our present handicaps to industrial progress.

For once Ed is right. He should stand by his guns, or better, keep firing salvo after salvo into this despicable method of getting or keeping business. His determination not to be a party to a tacit admission that the pump has failed in service should have the approval of every honest business man. —E. E. GAGNON.

The customer should be made to bear the expense of repairing the pump. It was through no fault of Al's that the difficulty arose. While it is granted that such procedure will probably result in the loss of future orders from this customer, it must be admitted that there are two classes of customers; good ones and poor ones. Poor customers are continually finding fault and demanding far more service without pay than they are entitled to.

In the event that more pumps were sold to this concern, if the pump were repaired without charge, there is a possibility that through the care-

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Flint, Mich.—Flint Manufacturers' Service
Houston, Texas—Sam H. Penny
Indianapolis, Ind.—J. W. Mull, Jr.
Los Angeles, Calif.—Almquist Bros. & Viets
Milwaukee, Wis.—Polhemus Co., Inc.
New York, N. Y.—H. E. Eaton Co.
Philadelphia, Pa.—H. E. Eaton Co.
Pittsburgh, Pa.—J. W. Mull, Jr., Motch & Merryweather Machinery Co.
Rockford, Ill.—E. R. Ekstrom
San Francisco, Calif.—H. E. Stallman
St. Louis, Mo.—R. T. Monahan
St. Paul, Minn.—Robinson, Cary & Sands
Syracuse, N. Y.—Roy W. Glahn
Toledo, Ohio—W. F. Haverstock, J. W. Mull, Jr.
Tulsa, Ok'a.—Brammer Machine & Tool Service

lessness of its personnel more trouble would be encountered at a later period, and that the customer would expect Al to make good.

—ROGER C. DICKEY,
International Paper Box Machine Co.

Assume that the engineer didn't let the bearings of the pump run dry on purpose. It was an accident—just one of those things. The engineer wants to protect his own job, and he needs an "out." Al's company can help him honorably, and in so doing, make a friend. Their attitude should be that whereas they know their pump was up to standard in every way, yet they realize that an engineer handling a new piece of equipment for the first time might reasonably and honestly fail to check the oil level as often as needed. For that reason and for the sake of friendly relations they are willing to go half way or even the whole way in meeting the repair expense.

If the matter is tactfully handled, Al's company shouldn't have to apologize for its pump, and should be in line for the next order.

—JAMES K. MATTER.

NEW BOOKS

DIE-CASTING — *By Charles O. Herb, 300 pages, 6x9 in., 178 illustrations. Published by The Industrial Press, 148 Lafayette St., New York, N. Y. Price, $3.00.*

All phases of die-casting—machines, dies and alloys—are discussed in a comprehensive manner. The treatment includes not only the more common die-cast alloys, but brass and the recently introduced process for die-casting of cast iron.

Not only does the book deal with die-casting machines of the latest type, but it covers die steels required for different die-cast metals and presents the analysis and properties of the commonly used die-casting alloys.

Dies have received considerable attention in the book, and have been classified in groups according to the most distinguishing characteristics in order to facilitate locating a general design or type adapted for a given class of work. Further, there is a section that illustrates and describes die standards adopted by a leading manufacturer of die-casting equipment. The book also contains a great deal of practical die-casting data relative to rates of production, pressure and alloys used for different applications.

MECHANICAL POWER TRANSMISSION HANDBOOK—*By William Staniar, mechanical power engineer, E. I. du Pont de Nemours & Company. 488 pages, 5⅞x9 in. Indexed and illustrated. Imitation leather binding. Published by the McGraw-Hill Book Company, 330 West 42nd St., New York, N. Y. Price $5.00.*

So many factors are involved in transmitting power from the prime mover to the point of application that the engineer or plant superintendent is likely to be confused in the selection of the method best suited for a particular application. Industrial plants have witnessed power transmission emerge from the status of a few

lineshafts transversing the length of a shop to many instances where each machine is individually driven. Most shops today find their optimum solution somewhere between these two extremes. It is the purpose of this volume to aid the production executive or designer in determining where that point is.

The material is presented concisely in what might be termed semi-handbook style; that is, the contents is arranged in chapters in which are included both general discussions and tabular matter dealing with specific branches of the subject. Such considerations as belting, pulleys, shafting, bearings, clutches and couplings, chain drives, starting devices, variable speed drives, gear reduction units, lubrication and electric motors are taken up in turn.

Some of the data are taken from the author's 1928 book "Mechanical Power Transmission," but the many changes since then, together with the demand for such information, made the new presentation seem advisable.

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ELEMENTARY MECHANISM.—*By Philip K. Slaymaker, professor of machine design, The University of Nebraska, 181 pages. 6x9-in. Published by D. Van Nostrand & Co., Inc., 250 Fourth Ave., New York, N. Y. Price, $2.25.*

Fundamental principles and their application is the approach made by the author, rather than attempting an exhaustive treatise. From long experience in teaching mechanisms he believes that knowledge of the subject is gained best by the student from an understanding of elementary concepts in logical order.

Special attention has been paid to motion transmission by linkage, because this division of the subject develops principles which are applicable to all other forms of motion transmission. Acceleration has also been given considerable attention, being treated not only in connection with linkage, but also in the case of motion transmission by direct contact.

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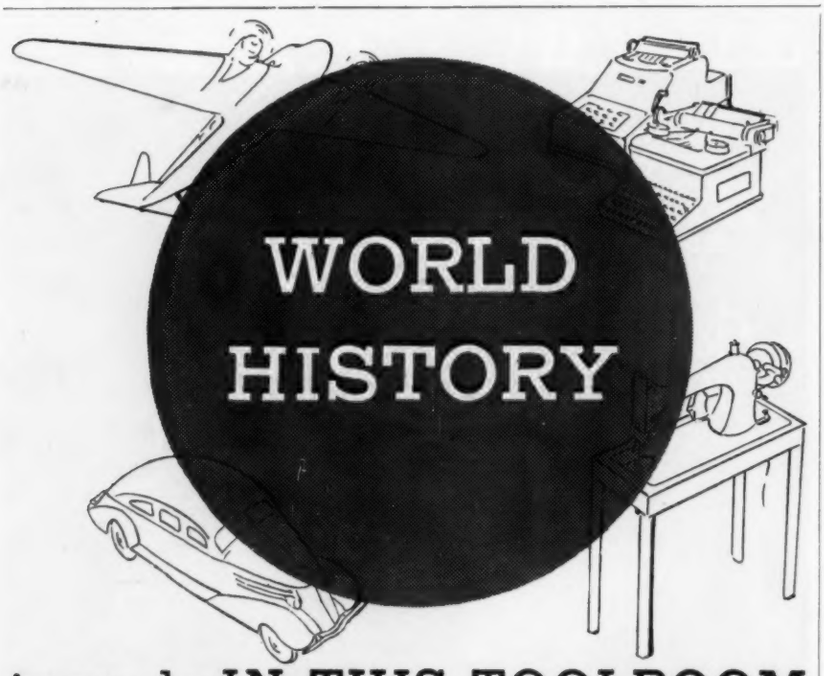
HANDBOOK OF ENGINEERING FUNDAMENTALS—*By O. W. Eshbach, Editor-in-Chief, and 40 contributors. 1,081 pages, 6x9 in., illustrated. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $5.*

Since mathematics, physics and chemistry form the basis of all engineering, these fields are dealt with in preparing a volume of interest to every engineer regardless of his specialty. The first section presents a selection of mathematical and physical tables. Other sections deal with such material as: the presentation of dimension systems, systems of units, standards, and introduction to the theory of dimensional analysis; theoretical mechanics and mechanics of materials; the modern theory of fluid mechanics, thermodynamics; electrical, magnetic and dielectric circuits; fundamental principles of general chemistry and chemical tables; light, acoustics and meteorological phenomena; properties of metallic and non-metallic materials, and contractural relations. A larger type size and larger illustrations than used in the older type of handbook makes the material easier to find and reduces eye-fatigue.



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Horses stepped out of harness, internal combustion engines stepped in—and America became a nation of neighbors. Engines grew wings—and continents were spanned, oceans vaulted, the poles of the earth safely circled in days instead of months. Flashing machines took the drudgery of the needle, the labor of the pen, out of human hands—the killing monotony of figures out of human minds. Hot news clicked into hot type with the speed of thought.

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